NERVOUS AND MENTAL RE-EDUCATION

BY
SHEPHERD I. FRANZ, M.D.

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NERVOUS AND MENTAL RE-EDUCATION

BY

SHEPHERD IVORY FRANZ

DIRECTOR OF LABORATORIES, ST. ELIZABETH'S HOSPITAL (GOVERNMENT HOSPITAL FOR THE INSANE), WASHINGTON, D. C.; PROFESSOR OF PSYCHOLOGY, GEORGE WASHINGTON UNIVERSITY

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PREFACE

The problems of readjustment, for the individual and for business and for the state, which inevitably follow war are most important at the present moment. Almost five years after the ending of the Great Conflict, many of these problems are still facing us, and it will take many more years before they are settled. One who is interested in the statistics of conditions will find many places in which they can be found. Although statistics show what exists or has existed, they seldom provide advice regarding the solutions. The present work is entirely lacking in statistics. It is intended to be of assistance in the solution of some problems.

Man power, which in these days should mean brain power and mind power, must always be conserved. What should be attempted is to adjust individuals to their environments. This is difficult enough when we deal with the normal, but it is increasingly difficult when we have to adjust the crippled and the diseased. Society, or the State, strives through education to fit individuals into the niches which they may best occupy, but at present this is poorly accomplished. The defective is left to a small group of physicians and others to patch up if they can. But, in their efforts, they are met with incredulity and disbelief, indifference and

even opposition. It is to show medical men who are not specialists in these fields, as well as the intelligent public, the general principles and the manner of applying them in the neuroses and psychoses, that the present work is published.

No one should read the book with the belief that it contains more than general statements of principles, and their application to one class of disorder, viz., that primarily involving the nervous system. Nor, even for those disorders, should it be understood that necessarily detailed programs are laid out for any one or for every patient. Each patient differs from every other, and all re-education prescriptions must include the final admonition of the best cook-books: "Salt and pepper to taste."

Repetition will be found from chapter to chapter. This has been purposely done, on account of the importance of the matter, because individual chapters may be read, and the applications should not be forgotten. For all kinds of readers, specialists as well as general, it is exasperating to find numerous references to earlier or to subsequent paragraphs. These references have been kept down to a minimum.

In the same general field, McKenzie's *Reclaiming the Maimed* should be read. In it there will be found more details regarding some of the methods useful in re-education. Some of the illustrations of the present book are borrowed by permission of Dr. McKenzie, to whom the author makes his general acknowledgment.

A few words may be said regarding some terms that have been used. It would be best if the pa-

tient could be called something other than "patient," something which would always convey to him, to his family, and to his friends, the fact that he is being fitted to take up his life work again. "Pupil," "learner," "scholar," and the more recently used "trainee" are useful but not good. Similarly with the term for the re-educator, who may be a physician or surgeon, but who frequently is not a medical practitioner. If in America the term "doctor" did not so commonly connote a medical practitioner, this term would be most suitable. In place of this we are forced for the moment to use the convenient "teacher," "instructor," and "physician."

My thanks are due to many who have supplied me with information, but to none more than to those patients who have been subjects of re-education.

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PART I

BASIS AND GENERAL CONCEPT OF RE-EDUCATION

CHAPTER I

WHAT IS RE-EDUCATION?

Re-education involves the same principles as other kinds of education, and in no particular do the general principles of education and re-education differ. It is well recognized that both the general and special education of any individual are matters of habit formation. Certain differences exist in the various kinds of education, but these differences are relatively slight as compared with the similarities. In general the difference between what is called education and that called re-education is a difference of direction or aim, or that of material. In education habits are formed on the basis of the instinctive tendencies of an individual who is endowed with a normal number and a normal quality of parts. When the individual who is normal loses some of his parts, or the parts become useless because of distant disturbances, it becomes necessary to utilize other parts as replacements if the individual is to be self-supporting or an active participant in the life of his community. The original instinctive tendencies, which depend upon the integrity of the parts assumed to be destroyed, cannot now be used in the formation of new habits, and other instinctive tendencies must be utilized. In some cases another part of the body is made use of.

In its broadest sense re-education, therefore, is a replacement of bad habits with better habits, or it is the formation of new habits to replace habits which have been lost. We shall appreciate this better if we consider briefly certain normal habits, how they vary, and what takes place in the process of re-education in order that there shall be a compensation for lost habits.

Some of the things we call habits are social; each individual in the social stratum has them. Others relate to smaller groups, and to belong to these smaller groups the individual must have certain kinds or constellations of habits. Still other habits are purely personal; they are of a certain character for one individual in a group or in a family. In fact, the term habit is used properly to describe more than ninety-nine per cent of the daily activities of a waking individual. We have habits of eating and of drinking, of dressing and of purchasing clothing, or using furniture and ornaments; we have habits of speech and of thought.

The child, whether black or white or brown or yellow, is born with certain instinctive tendencies to action. The movements are sometimes spoken of as reflex movements, but they do not differ materially from many other movements which are not of as definite a character. Appropriate stimuli will start the machinery so that a certain result is obtained. An object placed in the hand produces a grasping or clutching movement of the fingers, an object placed on the lips brings about a grasping movement of the lips and if the object is grasped sucking movements follow. As

the child grows older the parents, or nurse, make an effort to wean the child. Either the child is not presented to the breast of the mother, or the nursing bottle is not given to him. The resulting lack of satisfaction of hunger by the usual means causes the child to take on or assume an activity somewhat different from that to which he has been accustomed. The milk is presented in a spoon or in a cup, or a piece of food is given on a fork or on a spoon. At times it is difficult for the child to acquire this new method of feeding; he is, we say, refractory. But after repeated efforts the child soon adopts the method of taking his food which the parents or nurse desire him to adopt. He forms a new habit to take the place of the primitive reflex or instinctive activity, and this habit, it will be noted, differs according to the social environment.

After the period of suckling the Chinese baby advances to the use of chopsticks. Children of the so-called western civilization acquire the habit of using a spoon, a knife and a fork. Some learn—form the habit—to hold the fork in the left hand, and consistently hold it in that hand whenever a knife is also employed at the same time. Others change the fork to the right hand after the meat or other food is cut, and do not learn to use the left hand for the manipulation of the fork in conveying food to the mouth. A few learn to use the knife in the left hand and the fork only in the right, these being the left-handed. Later in life some of the left-handed also learn to use the knife with the right hand and the fork with the left as most other persons do. They try

thus to conform to the habits of the great majority of the community in this respect. Other differences in the habits of using table utensils are readily seen by an observer. These differences are very evident at the popular lunch counter. Here there will be observed very different habits of manipulation of knife and fork and spoon. A variety of ways of using napkins and of arranging dishes may also be seen. In addition the actual operations of eating, whether one chews his food thoroughly or almost bolts it as do many animals, the sipping of drinks, and even the insistence on certain combinations of foods in a restaurant are habits.

Let the right-handed reader observe himself while stirring a cup of tea or coffee with a spoon. The movement is made evenly, without difficulty. Then let him try to do the same thing with his other hand. The movement is irregular, awkward or incoördinate, and difficult. The left hand and arm have not been taught to do this; they have not acquired the special habit. But if periods of practice are taken, the left hand will acquire the habit so perfectly that the movements will be performed as quickly and as regularly as are those with the right hand. The adjustments, nervous and muscular, are made after a few practice periods, and the left hand and arm may therefore be used instead of the right. There has been a kind of re-education, that re-education which is of the nature of substitution.

In dressing a man habitually places one leg into his trousers first, be that the right or the left. He has learned—he has acquired the habit—to

make certain movements in a regular course in putting on his clothes, and he uses his hands in certain definite ways in doing these things. His collar is grasped in a certain fashion, his tie is turned by the right or by the left hand, he laces his shoes and ties the knot in special ways. These things are done rapidly and accurately. The recruit has not acquired any special habit with his soldier clothes, his leggings feel peculiar, he works over them until they are finally adjusted. His hat strap bothers him, and it takes him much time to get it in such a position that he is comfortable. Compare this with the veteran, who appears to make his adjustments with ease and without obviously special care. The latter's habits have, however, been formed, and his dressing has taken on that habitual character which is noticed in the civilian. Let the soldier or civilian encounter a condition that makes necessary a new movement, and he becomes slow and inaccurate. When the buttonhole on the collar band is a trifle large, there is considerable fumbling until the proper adjustment is made.

When one has been accustomed to wear suspenders and changes to a belt, he usually finds the change uncomfortable; he has the feeling of incompleteness or of lacking something. He has become habituated to making reactions with the pressure of the suspenders on his shoulders and his reactions are not as ready and as comfortable without this pressure. Conversely the reactions of an individual are awkward when he begins to wear suspenders after having worn a belt for a long time. He has acquired the habits of reaction

with his trousers supported at the hips, and it takes him some time to adjust to the unusual condition. Let a man don a woman's sweater and try to button it. The buttons are on the left side instead of on the right, and he gropes (for he has formed this habit) with the right hand for the buttons. If he is to wear the sweater for any length of time, he must become re-educated to use the hands differently. In other words, he must form new replacement habits.

The purchasing of certain foods and of certain special articles of clothing and other supplies is largely a matter of habit. This may be illustrated well by an extreme example. The steady drinker of alcoholic liquors forms the habit of stopping at certain saloons en route from his work. If one of his oases is closed he experiences actual discomfort; his schedule is thrown out of plumb. In his walk he stops at the usual place, although he knows the place has been closed, and for many days, even though he may not stop to turn in, he hesitates in passing the place. In this case, as in many of our activities, the stimuli in sequence act successively to bring about reactions. Many persons have the habit of using a certain sort of pencil and paper, and are unable to perform their work if the special kinds are not available. We go to special shops for special things, although we might satisfy all our wants as cheaply and as well in one large store. We buy neckties of a certain color or of a limited few colors or patterns. Some purchase only ties that are bizarre, and others only those that are quiet in color tone, regardless of the color combinations.

Many persons explain these habits in intellectual terms. They say they buy a hexagonal pencil because that kind of pencil gives them the best results; they can hold it better than a round one. They contend that the having of a pocket on the left breast of a coat is useless, and at times dangerous because of the possibility of loss therefrom. They require their tailors to make their coats without that pocket and with an inside upper pocket. It is a fact, however, that we use a certain pencil, hard or soft, or round or hexagonal, because of habit. That kind of pencil was used by us under certain special conditions, and whenever these conditions arise we demand the same kind of implement for the proper performance of the work. So also with the pockets which the tailor makes in the coat. We have formed the habit of using the left-hand inner pocket for a note book and the demand that the coat be made in this way is in reality a demand that our habits shall not be interfered with.

An individual wears ornaments to which he has become accustomed—which he has formed the habit of wearing. There are many peculiar habits attached to these decorations. During a lecture or an address, or even in ordinary conversation, some speakers continually manipulate their eye glasses on their chain. Others fumble with their watch chains, or twist the chain around one finger. By force of habit we wear certain rings on certain fingers. If a man is accustomed to wear a pin in his scarf and loses his pin, he experiences a feeling that something is lacking until habit is satisfied and he has another pin. After wearing a

wrist watch a number of years a man may retain the habit of raising the arm to learn the time, even if he has discarded that kind of watch. Not infrequently the habit of wearing such an ornament as a wrist watch results in laughable situations. Thus the writer has seen a woman at a bathing beach unconsciously continue to wear her watch when going into the water. The habit of wearing the watch is so firmly fixed that the new situation does not inhibit it, even though dangerous to the watch. Doubtless if the woman were asked she would say she never wore her watch when taking a bath. The habit of wearing it was replaced by the habit of taking it off under the usual conditions of bathing.

Because of habit we sit on chairs, we sleep in beds, and we write on tables and on desks. Were it not for habit, what a painful process it would be to learn the use of a telephone each time we desired to use it! A man that has formed the habit of pressing a button beside a table in his club, if he desires a bell boy, will experience actual discomfort if he is a visitor in a club where bell boys are called in another fashion. As an evidence of habits formed in that way, consider the difficulty many persons have in sleeping in Pullman cars. They have formed the habit of sleeping in their own beds, which have a certain degree of softness or of hardness, and which have pillows of a certain thickness and ease. When these conditions are changed, and especially when there are added to these special differences the inclosed space, the motion of the train and the noise, the new combination frequently overcomes the physi-

ological necessity of sleep. These things act as stimuli against sleep; they interfere with special habits. Some persons have not formed the habit of sleeping in one place under one set of conditions. They travel extensively and their physiological need for sleep is not adversely influenced by hardness of the bed, by the size of the pillow, by noise or by other slight variations from what most persons consider the normal. They are able to sleep on a hard bench or on the ground, they sleep in a narrow berth on a steamship, or equally well in an upper or a lower Pullman berth.

Consider how in writing a letter we have the habit of saying: "My dear sir," "Yours truly," "Respectfully yours," and so on. All these verbal forms are of an habitual nature; they are not dictated by intellect. The writer may despise him whom he addresses as "dear sir." He may feel nothing but contempt for the man to whom he writes "respectfully yours." But he has the habit of beginning and of ending a letter in that fashion, and thus he writes it. One lifts his hat when he meets a woman acquaintance. He salutes his superior officers. He offers his arm to a woman companion. He does these things because it is his habit to do them. So an individual has an habitual manner of addressing different persons under varying conditions. He may say "How are you?" or "How do you do?" or "Hello." Some men have the habit of saying "Ah, there!" by way of greeting. It is all a matter of habit.

Whether a child learns to speak English or Chinese is a matter of the reception of certain

stimuli which bring about the special habits. The speech mechanisms of a Chinese baby and of an American baby are essentially the same. The Oriental and Occidental manners of speech vary according to the habits that are formed. But not only is the kind of language a habit, but most of our daily conversation also consists of a collection of special vocal habits. We say those words we have frequently said before; we use phrases to which we are accustomed. Habit, then, not only forces us to speak English, French, Chinese or Pali, but it also regulates or compels our intonations and our utilization or non-utilization of certain words and phrases. One group of Americans is noted for its nasal twang; in other words for its habit of so using the vocal apparatus that this special intonation is apparent. This manner of speaking can be corrected or replaced by a non-nasal speech by suitable practice. A new habit can be formed—there can be re-education—so that the speech approaches that which is called normal. Another group of our people is noted for a drawl, but this also gives way to a more normal manner of speech if attention is directed to the production of this habit. Expression also is habitual. A man learns to swear, and he uses oaths of all kinds to begin, to fill in and to end all his sentences. Colloquialisms and provincialisms also are matters of habit; they disappear when new and more conventional habits are formed.

Even modes of thought move along paths of habit. The physician, habitually looking for them, sees pathological conditions everywhere. His attention is directed to abnormalities—a cough of a

certain character, a limp, a peculiar expression of listening. Many of the things to which he pays attention do not attract the attention of the layman. The machinist has his own habitual methods of thought. He considers an engine in terms of materials and finish and the methods used to produce the object. A humorist can pick out of a situation certain elements lost to the majority. An experienced newspaper man views an accident or a crime or a fire in terms of a "story." Each has his own habit of thought and applies it to every situation. If for any reason the physician or the machinist or the newspaper man is compelled to give up his special work and adopt another vocation, he must learn the habits of action and of thought appropriate to his new occupation. The one-time physician who becomes a business executive can no longer react to skin colors, or to limps, or to other indications of pathological conditions. He is re-educated to think in terms of work-hours, or of work-hour-tons, or of overhead costs and the like. And the humorist cannot be successful as a lawyer if he retains his habit of selecting the bizarre and of pointing out the unexpected; he must form the habit of looking at a case in a different fashion. The physician changed into a business executive may retain a certain number of his former professional habits and the humorist who has been graduated into the law may still retain his ability to tell a funny story or to make a joke, but neither of these men can successfully follow his new calling and retain all his old habits. Some of his habits must be replaced by others.

So much for the education of so-called normal individuals. The same principle of habit formation obtains in the re-education of the abnormal. For instance, the problem that confronts the man who has lost his right arm by amputation near the shoulder is that of forming a number of new habits that will compensate for the loss. All the useful habits of the lost arm must be replaced by other habits if he is to approach his normal uninjured condition. Some are replaced by the formation of habits of using an artificial arm and others by the utilization of the left arm and hand. The use of an orthopedic appliance, such as an artificial arm, involves the learning of many new adjustments. Some appliances have been so ingeniously constructed that the defects due to an amputation near the shoulder can be overcome, even to the use of fingers. One of these artificial arms, constructed and used under the direction of the eminent French re-educator, Amar, permits the patient to use a typewriter, play billiards, and make many other fine adjustments. It is important, however, to realize that these fine movements are acquired only after a long period of practice. New habits must be acquired. The many straps and connections on this arm are manipulated by movements of the muscles of the shoulder girdle, of the neck, and of the other arm. There is here a functional replacement in which the groups of large muscles learn to move in a fixed way, in other words their habitual manner of reaction is replaced by a new habit. The Amar arm is useful for only a few individuals. The time required to learn the use of this appliance is

long. In many cases it is realized that the finer movements are relatively unimportant, and in these latter cases use is made of much simpler appliances. The grosser forms of adjustment can be learned in a short time. This is especially true of those efforts toward providing re-education for certain kinds of work, such as farming. The use of a spade, the driving of a horse, the direction of a plow require steady but not fine movements, and an artificial arm with a hook or with a claw can be substituted for the more elaborate arm which is needed for typewriting.

But even if many habits are regained for the lost arm by the use of an orthopedic appliance, it takes too long to acquire many important habits involving the finer movements. Some habits that depend on fine coördination—such as those involving use of the fingers—must be replaced in another way. It is impossible to adjust many artificial arms so that they can compensate for all purpose of the lost arm. It becomes necessary to train the remaining hand and arm to perform these delicate operations which are most needed. This kind of education takes less time than that of the utilization of a complex artificial hand and arm, and is most frequently attempted. The man then learns to use his left hand for the performance of those acts in which he formerly used both hands, and for those acts in which he formerly used the right hand. He learns to button his clothing, to tie his shoes and to open his purse. Many other common daily tasks are carried out with a surprising degree of speed and accuracy by his new adjustments.

This represents one type of re-education—the type in which there has been anatomical loss. Re-education in this sense is the formation of a new set of habits by one side or by one part of the body to take the place of old habits that were lost because of the loss of another part of the body. This type of re-education takes place also in a number of cases of paralysis.

In the re-education of persons with speech defects an attempt is made to teach the individual who speaks badly, who stammers or stutters, to replace the old habit of speech by a habit more normal. This is done by correcting the defects due to nervousness, by showing the individual the normal, correct manner of placing his lips and tongue to form certain sounds, and by requiring him to form new habits of a correct kind, and by forming the habits of coördination of respiratory with tongue and lip movements. In this case re-education involves the production of a good habit to replace a bad or an ineffective habit.

Persons suffering from aphasia—loss of the speech function—must also be re-educated if they are to be comfortable and useful. In these cases the process is similar to that of the education of a young child who has not already learned to speak. In reality the aphasic condition is nearly like that of the infant, with the notable exception that the aphasic has been able to speak at one time and has lost this ability. The aphasic must be taught anew to use his speech muscles in the proper ways. He must also acquire habits of coördination of these muscles, so that his vocalization corresponds with that of normal persons. He must learn that

"h-o-r-s-e" is to be pronounced "horse," and not "ou-ey." He must form the habit of speech reaction practically from the beginning, knitting or combining the movements of his vocal apparatus so that he emits sounds which are recognized by others.

Brief mention may also be made here of the principle of re-education with another abnormal class—that of the insane. A careful analysis forces us to conclude that insanity is in essentials the condition or conditions in which certain habits normal to persons of the indivdual's station and class are lost, or in which the habits of reacting of that individual are replaced by bizarre or perverted habits. In other words, an individual is insane when his reactions or behavior differ from the normal. The individual becomes well, or he makes a social recovery, whenever his habits become like those of his own class and station. The re-education of the insane depends entirely, therefore, upon the replacement of bad, perverted, peculiar, slovenly and unsocial methods of reaction by habits which are social and conventional.

In simple terms, then, the principle of re-education is that of habit formation. It is either a replacement of old, inadequate, or harmful methods of reacting with new habits more like those of the other individuals in his environment, or it is the formation of new habits to take the place of those that have been lost. In other words, re-education is to the abnormal what education is to the normal —it is a matter of the acquisition of habits that will enable the individual to take his place in the working, playing, social world.

CHAPTER II

THE FOUNDATION OF HABITS.

In order to appreciate better the application of the principle of habit formation to re-education, it is advisable to know how certain habits are formed, and some of the conditions which affect habit formation. Much of the knowledge we have acquired on normal individuals may be applied to those conditions of the abnormal which require re-education. Much of the published work on this subject deals with the formation of habits of relatively simple characters. Much of it, which is very instructive, also deals with habit formation in simpler organisms—animals. The results of the studies on the formation of habits in animals are important in an investigation of the much more complex organism—man. They are also important because the consideration of the simple habits leads to a better understanding of the far more complex habits that man must form.

Habit has been defined as "a new form of adjustment acquired during the lifetime of an individual." This excludes such forms of activity as instincts and those simple, congenitally present reactions which are called reflexes. Every activity of an animal requires a stimulus (sometimes producing a sensation) which sets off a reaction (which is sometimes glandular, but most fre-

quently a movement). It is the constant junction or the combination of a special reaction with a special stimulus that is properly known as a habit. There are, therefore, two main elements in the habit—the sensory and the motor.

When we carefully examine an individual we find that the habits exhibited are of different characters. This has already been seen in the preceding chapter, in which habits of dressing, habits of thought and habits of other characters have been mentioned. Not only do the habits of a man differ according to the special goal—whether the motor response is one for personal pleasure (such as dressing as a protection against cold) or for social purposes (such as those associated with meetings or the theater)—but they also differ according as the emphasis is placed on the thing that sets off the reaction, or on the actual reaction itself. Because of this two great types of habits are usually described, the motor and the sensory. In essentials these two are the same; they differ only according to the direction of the emphasis placed upon the "acquired adjustment."

The motor habit is a mode of reaction of a certain definite character to a certain kind of stimulus. Thus, we have learned to turn the handle of a door away from the door casing, regardless of the special shape of the handle. The sensory habit is a mode of reaction in which the movement or other activity is considered to be associated with one stimulus rather than with another. It is conceivable that the sight of a large dog might bring about the same reaction of running away as does that of a wolf of similar size, but the discrimina-

tion of these two stimuli usually is made, and the resulting reactions differ. The emphasis is here placed on the discrimination rather than on the movement.

The differences are well illustrated by the reactions of different animals which are placed in a certain environment that gives a definite or fairly definite stimulus. Since many observations are at hand respecting the habit reactions of cats, let us consider briefly these animals as examples. If a cat is placed in a box so constructed that the reactions of the animal may be observed, but from which it cannot escape except by the manipulation of a specially arranged adjustment, the cat goes through a variety of activities. These are largely of the nature of instinctive attempts to escape from the inclosed space. The animal scratches the bars, or bites them, or scratches the door or the cover, or bites any projecting portion inside the box. We say it attempts to escape from the uncomfortable situation of confinement. Eventually in its instinctive but rather random movements—random as far as the immediate result of escape is concerned—a movement is performed which is followed by the opening of the door of the box. The fact that the door is opened may not, however, be appreciated by the animal for some seconds after this has occurred. The first time the test is made with an animal escape may not result in less than ten minutes. If the experiment is repeated it is observed that more of the activities of the cat are directed against the door and the immediate neighborhood of the door. If the opening of the door can be brought about by

the manipulation of some mechanism near the door the cat may open the door relatively soon in the second experiment. The time of opening the door in subsequent trials gradually becomes less until after thirty to forty trials the animal executes the certain movement almost immediately it is placed in the box.

The final, or what may be called the purposeful, movement need not have any direct relation to the means of escape, such as the door or cover or any part through which the cat may get out. The movement may be as far removed from the situation of the confinement as the experimenter wishes. The experimenter may predetermine that he himself will open the door when the animal scratches itself. A habit of this character can readily be formed, provided there is a suitable instinctive basis in the animal and also a suitable reward or a desired end to be attained. It is well to keep in mind that the two habits which have been mentioned—the opening of a door by a nearby mechanism and the opening of the door by the execution of a movement not apparently related to the result—may not be acquired equally readily. It has been found easy to produce a habit when the movement is one fairly definitely associated with the means of escape. It is usually more difficult to produce a habit in which the result (in the case under discussion this is escape) is not closely associated with the movement.

Furthermore, the experiments with cats show very well that the same situation may result in different habits. A good example of this is with respect to the activities of different cats in a box,

the door of which can be opened by moving a string which is attached to a latch. One cat learned to do this by arching its back and by rubbing against the string, thus exerting enough pressure to move the latch. A second animal acquired the habit of biting and pulling the string, and a third cat clawed and pulled the string. All these are motor habits. Each animal has learned to move in a special way when it receives certain stimuli (the sight and the feel of the particular box) and the special habit which is produced depends upon the instinctive reactions of the particular animal.

The sensory reaction differs in only one respect from the motor reaction. Here, as has been mentioned, the emphasis is placed upon the discrimination of sensory stimuli. Thus, the cat may be placed in a box so constructed or operated that the door will not open unless certain conditions are fulfilled which are not obviously related to the movement. Or, to put the matter in other words, the movement of pressing a button or pulling a string will not open the door unless a red card is simultaneously exhibited at the right hand side of the box. If a green card is at the right hand side of the box no amount of pulling the string or pressing a button will result in the opening of the door, nor will this result be obtained if either of the colored cards be at the left hand side of the box. The appropriate movement is efficacious only when there is this other special condition. The habit is said to be formed when the animal makes the appropriate movement only when the red card is in the correct position. In this case there is

some kind of sensory discrimination—"red card, right," as distinct from "red card, left," "green card, right" and "green card, left." Such discrimination need not be made in actual verbal or ideation terms, but if the appropriate reaction follows one special stimulus rather than many we call the process a sensory habit.

A third type of habit is sometimes described and differentiated. This is the delayed reaction habit. This type does not differ in any essential respect from the sensory and the motor. In many, perhaps most, of the motor and sensory habits, the reaction follows the stimulus immediately. In the delayed reaction habit the reaction does not follow directly upon the stimulus. A little consideration serves to show that all habit reactions are somewhat delayed. In some cases the delay is great, but in the motor and sensory habits the delay of the movement after the stimulus may be only a second or two. It is, however, sometimes a convenience to contrast the delayed reaction habit with the more direct habits. This type is frequent in human conduct. It can be illustrated by the action of the man who has learned to use a dictionary or encyclopedia. When in his reading he encounters a word or a statement of an historical event he may not have his dictionary or encyclopedia at hand, but at a subsequent time he does consult one or the other. When the experimenter with cats determines beforehand that he will not permit an animal to make a movement directly a stimulus is given, but will permit the animal to react only after an interval, let us say five or ten seconds, he tries to produce a delayed

reaction habit. In a case like this it has been found that the habit is not produced as readily as are those habits in which the reaction follows the stimulus immediately. The application of this knowledge to the production of human habits is important.

It has been found that differences in the required movement, the distant or close relationship of the movement to a particular stimulus, and the delay in the response will affect the rapidity of habit formation. Other factors are also of importance. When the adjustments are fine and numerous and when the sequence of movements is intricate a habit is acquired only after a considerable period of practice. When the movements are relatively gross and few, and in direct relation to a particular event, habits are learned quickly. Let us consider such a situation when the object is escape from a box. If the door is pushed, resulting in the opportunity for escape, this pushing of the door is in direct relation to the desired result. The movement is also relatively simple and gross. When the door is released only by a definite combination and sequence of movements, such as (a) pushing a button at the back of the box, (b) pulling a string at the corner opposite the door, and (c) standing upon a raised platform in the box, the habit is formed slowly. Some animals within the limits of the experiment cannot learn this indirect, complex, delayed reaction habit.

It must also be recognized that the apparent difficulties of movements are not the same for all individuals. Some persons are able to execute

finely coördinated movements as readily as others execute larger and grosser types. The difficulties of movement bring about differences in the rapidity of formation of habits. This is especially noteworthy in dealing with pathological material, such as diseased human beings. Moreover, it must also be borne in mind in re-education work that a disease does not always produce exactly the same deficiencies and difficulties. One patient with a paralysis may be different physiologically from another patient who superficially appears to have the same defects.

Certain reported facts are helpful to us in estimating the best means of bringing about the desired results in the formation of habits. To return to the facts in animal experimentation it has been shown, for example, that if certain animals of the same heredity and of the same age are given the opportunity of forming the same habit the rapidity with which the habit is formed differs in accordance with the number of trials given. With white rats placed in a simple maze it was found that one group given one trial a day learned to go through, in other words formed the habit, in seventeen days. Those given three trials a day took only nine days, and those that had five trials a day learned in eight days. It was also found that a similar group given only one trial every second day took thirty-two days for the formation of the habit, and another group, having one trial every third day, required thirty-nine days to learn it. This illustrates very well that the frequency of the trials or of the efforts is a potent factor in the production of a habit.

On the other hand, these figures illustrate that there is the possibility of wasting time in attempting to produce habits under certain conditions. It is obvious that the animals that learned the habit in eight days had forty tests before they acquired it, while those that had one trial a day learned in seventeen tests and those that had but one trial every third day acquired the habit after thirteen tests. It is possible that by permitting an animal to have 150 to 200 trials in one day a habit could be acquired in that one day. In such a case the amount of time, in minutes and hours, spent in the formation of the habit is entirely out of proportion to the time used if the animal is given one trial each day. We may look at the rapidity of habit formation in these two ways. If speed in days be the desideratum, there may be as many trials a day as are within the animal's or the man's limit of fatigue or endurance. If, however, it be desired to have the habits produced with the least amount of effort, the trials may be separated by relatively long intervals of time (days or hours). It appears that there may be a limit in both directions. If the individual trials follow one another too rapidly, mental and physical fatigue may be produced and the formation of the habit be interfered with. If, on the other hand, the time between successive trials is too great, the man may not get acquainted with the situation, or may forget what he has previously done, and each successive trial may be almost the same as a perfectly new one. The optimum condition probably is one in which the habit can be formed with the least effort in the least number

of days, without deleterious fatigue. What this optimism is for different habits is yet to be discovered. In all the applications of the principle of habit formation to human individuals the two conditions just mentioned must be kept in mind, and for each patient worked with a judgment must be made, even though this judgment is not based entirely on scientifically demonstrated results.

Another element upon which habit formation depends is the recency of the stimulus. Here we deal with the so-called delayed reaction. If the reaction be very much delayed the habit is very hard to form. The reaction must follow the stimulus closely if rapidity in habit formation is to be desired.

The retention of habits may be considered briefly here, since to be of value a habit must be retained for some time after the training period; in other words, the reaction must follow the stimulus as a regular event whenever the stimulus is given. This is the case after as well as during the so-called period of training. In the production of habits in animals, and even in children, certain arbitrary limits have been placed upon the special training periods. In some cases it is assumed the habit is acquired if the animal performs the appropriate movement in three or four successive trials within two or three seconds after the stimulus has been given. In children the arbitrary rule in school is much the same. In order that the habit reactions may come with more predictable regularity and with less variations in speed, it is customary to give practice to the individual beyond this point of learning. When this is done,

it is called over-training. Over-training results in having the habit firmly fixed, so that after, let us say, an interval of a year, the special movement will follow the special stimulus. In such an event the habit becomes like a reflex. If, however, the amount of training is only that which just suffices to make the reaction follow the stimulus, the habit may not be evidenced in the same situation after an interval of twenty or thirty days or even three or four days. Those speech habits called "cramming" are examples of this. The student forms the habit, by constant repetition for a day or two —"Discovery of America, 1492," or "Franco-Prussian War, 1870,"—and is able to reproduce these; he has the appropriate reaction to the stimulus for a short time (perhaps only twelve hours).

Certain habits persist even though the special stimuli leading to the reactions have not been encountered for some time. These are all habits in which there has been over-learning. Thus, for example, a man may be able to skate ten or twelve years after he has ceased to practice this accomplishment. It is true that the movements may have lost some of their accuracy, speed and force, but they are still present in sequence, and in sufficient accuracy to show the persistence of the habit. So one may retain the habit of making the proper strokes in billiards, although the accuracy of execution is lost in the years without practice. After years without a piano, an individual may sit at one and play a selection he learned long before. He may not play it as smoothly or as accurately, but there remains the habit of making one movement after another, in a certain direction

and of a certain amount. The inaccuracy is due to the failure of habit in a fine way; failures in sequence, failures in force and failures in extent of the response. One may retain the habits of speech of his childhood after many years in another land. On returning to his childhood home his selection of sentences and ideas may not be as smooth as it was, but the speech habit itself is retained. In habits of this sort, it is important to note, there usually is a loss in one or more of three conditions—directness, fineness and speed. Thus, for example, an individual who has not spoken French for years may respond to a Frenchman in French after framing to himself his reply in English; that is a loss of directness. The habit of playing a certain selection on the piano persists, but the music is halting and not nearly perfect—the fingers do not always strike the right keys; that is a loss of fineness. After a long absence from his machine the typist finds the keys readily by habit, but he is unable to write as rapidly as formerly; that is a loss of speed.

The previous training and the general capability of the individual must be considered for any kind of job and they have special importance in re-education. For instance, one who has learned to dance acquires the habit of performing a new dance much more readily than one who never has learned any sort of dance. The Russians are reputed to have notable ability to learn languages. If it be so, it is because they have the habit of learning languages. A person that has many habits has a greater possibility of response to a new situation. The more habits an individual has

acquired the greater his capability for learning yet more habits; he has that which might be called a situation reaction. He has an ability to react in a general way to many classes of situations that present conditions in some ways like those to which he has acquired an habitual reaction. He has learned to eliminate extraneous movements, for he recognizes in a situation a condition that calls for a reaction of a general kind, and he cuts out the unnecessary steps in reaching the result. Thus the cat, once it has learned that it can release itself from a box by pulling a string in front of the door, will eliminate the scratching and biting and searching that preceded its escape in its first attempts. In other boxes it directs its efforts at once to the door, finding easily in the new situation the latch or button that opens the way.

In education—and thus in re-education—we should seek to produce a considerable number of situation reactions. We are not concerned entirely, and perhaps not primarily, with teaching the paralytic to use his fingers to grasp a knife and a fork. We seek to re-educate his fingers and arms so that they will react properly to situations, to a razor, to a towel, to a hoe or to a pen.

This re-education, and all education, is possible, however, only if the subject is willing to undergo it. The child is sometimes forced to attend school and to learn his lessons because of fear of punishment. He is forced to form habits of cleanliness because of a desire to escape the pain or the discomfort of a whipping. He also forms habits of eating from a plate and of using a knife and fork and spoon because of his desire for food, and thus

of escaping the discomfort and pain of hunger. The usual incentives for a young child to form habits are those connected with an avoidance of pain. These are incentives which are part of the more general tendency acting for self-presevation.

A second general incentive toward habit formation is that of sex in its widest meaning. It is more usual to speak of these incentives as social. As a usual thing this is evident later in life, when the desire for freedom from the restraint of parental authority and the desire to have a home for one's self, as well as the special sexual impulses, act as supplemental stimuli in education. The wish to be independent, that to "do as one pleases," is a powerful reinforcement to acquire those habits which will enable the individual to be self-supporting and capable of supporting a family.

These two incentives, self-preservation and sex, the personal and the social, must also be made use of in re-education. Much attention has recently been directed to the mental attitude of helplessness, of dependence, and of hopelessness, which frequently accompanies disease. In some cases it has been found an easy matter to replace this attitude by one of effort and endeavor, of a desire for independence, and of willingness and confidence and optimism. This latter attitude can always be produced and fostered by proper direction of the patient's attention to those two wellsprings of habit—that of personal advantage and welfare, and that of social prosperity.

CHAPTER III

MENTAL ATTITUDE AND INCENTIVE.

The production of a sound, normal mental attitude in the patient must have a primary place in all re-education work. It is an integral part of rehabilitation in all its stages. An attitude of hope and helpfulness must be instilled at the start. A will to get well must be created if it does not exist. It must be developed as the re-education goes on, and it must be firmly established if the patient is to attain the mark at which he is encouraged to aim—total victory over the conditions that disable him.

A patient without hope, discouraged by his physical abnormalities or disabilities and resentful of the agency that produced them, is a difficult patient. He complains bitterly against a world that has dealt hard with him, and from railing at conditions in general he falls into the habit of railing at things more specific—his food, his treatment, his bed, his environment. The discouraged and hopeless patient believes nothing can help him. He cannot see the value of curative work in the process of re-education. Each time something is done for him, each time treatment is prescribed, he asks himself, "What good will this do?" And always he answers himself, "This will do me no good." He feels he is helpless, and

it may almost be said he has reached a stake at which he "doesn't want to get well." Some such patients even reach a stage at which they take a sort of morose pleasure in their abnormalities, and they would probably regret a sudden functional restoration.

When the patient is a mental case, when the abnormality is a psychosis dominated by depression, the helplessness and the hopelessness are much beyond those of the physically incapacitated patient. In such a case the removal of the depression, if that can be accomplished, results in the complete restoration of the individual. In such an individual the depression is often accompanied by the belief that he is unworthy of any attention, and that he should not take up the time or have the benefit of the advice of his physicians, his teachers and his friends.

There is the listless patient who feels sorry for himself and awaits only the day when it all will end. He wants to do nothing; he will not exert himself to the slightest degree if he can help it. He may do the things he is told to do—exercises to bring about his restoration, for example—but, if so, he does them with the idea of finishing a disagreeable task, not with the thought of helping himself. Perhaps during the time he is receiving the treatment no thought of recovery enters his mind; he gives little heed to the thing in hand. What is accomplished with a patient of this class is done without his coöperation and frequently against his active opposition.

Of course very many patients refuse to be discouraged. They refuse to consider themselves

doomed to a life of helplessness. They strive to return to normal, useful ways of living and exert every physical and mental means to assist those persons who are trying to re-educate them. Not infrequently they refuse to consider that they are temporarily incapacitated. They plan optimistically for the day when they shall return to the world of activity. These men of fighting spirit have the mental attitude that must be developed or fostered in the others. And often the hopeful patient, by his optimism and his refusal to accept his deficiencies as permanent disabilities, is one of the chief agents in the mental re-education of his discouraged comrades. He can be made a most helpful adjutant to the restoration of his more depressed companions. On the other hand it must be recognized that too great optimism is likely to lead to a reverse condition. If the optimist is permitted to retain too much assurance, and he fails to get well as quickly and completely as he expected, he is very likely to become depressed. With such an individual, however, a little, a very little, cautioning may tend to prevent an exaggerated expectation.

Most patients are keen to take in everything that pertains to their conditions, and this keenness, egoism in a way, may result in their listening to physicians, nurses, visitors and friends discuss their chances of recovery. A discussion of the patient's chances of recovery by his physician may have a good or bad effect. If in the presence of the patient the physician tells a nurse or a colleague that the patient's condition is unfavorable, the words need not be heard, the facial ex-

pression and the reactions of the listeners are usually sufficient to produce an unfavorable attitude. Many a patient has been discouraged by the words of his physician at the very beginning of his disability. A physician may tell a man who has been paralyzed because of a cerebral hemorrhage that he never will walk again. The statement that the paralyzed leg never can regain its functions remains stamped in the patient's mind; he comes to regard his condition as hopeless, and he makes no plans for a future in which he shall be able to walk again. "The doctor told me I couldn't get well, and this will do me no good," is his attitude toward all treatment. At last he reaches the point at which he can conceive nothing except a restricted life in an institution for the incurable or as a helpless dependent. At times the physician's casual remarks lead to marked mental disorder. The case of an officer in charge of an ambulance unit is an excellent example of this. He had been sent to a hospital near the front and there overheard his physician tell another "There is nothing the matter with him." This led to the development of the delusion that he was to be shot. This idea arose by a course of reasoning somewhat as follows: "The doctor reports there is nothing the matter with me; I have reported sick; if they decide there is nothing the matter with me, they must think I am 'faking'; this means court-martial, and I shall be shot." Great care must be taken that nothing is said or done that can be adversely misinterpreted by the patient. In some instances the neglect to encourage the patient is almost as potent in the production of an

improper attitude as is a direct statement. A conference of the family with the physician after the latter's visit to the patient may be very harmful. The patient is suspicious that something he should know is being withheld from him. A deceptive optimism is a hundred fold more valuable than a pessimistic frankness, except in those rare instances in which the patient is too eager and rash.

Many factors must be considered in a thoughtful attempt to overcome an indifferent or depressed attitude in the patient and to replace this by a sound mental attitude. Not all discouraged, hopeless or deluded men may be approached through the same channel. Different incentives must be used in different cases; in one man it may be a desire to support his family, in another it may be a desire for lost comforts, in another it may be a desire to escape ridicule, and in still another it may be a wish to be released from the care of others. A thing that appeals to one man as a goal to be striven for may appear inconsequential to another. It should be the first aim of a person attempting to produce a proper mental attitude in the patient to look for that incentive, or those incentives, having the greatest appeal to the particular patient. After the ambitions are known, they may be used in varying combinations, in various ways, and by direct and indirect approach to bring about the desired result of interest and effort.

The treatment itself may be made use of as an incentive. The patient should not be dealt with as if he were an incapable infant. He should be

given such occupation, exercise, or other treatment that he can appreciate, to some extent at least, as appropriate to him. The stringing of beads may be an occupation of value to the patient for the production of accuracy of movement and for training in speed and in concentration, but other tasks may be found which will appeal to him as more appropriate to his mental capacity and to his station in life. If he is capable of doing something useful, and if this useful occupation is as good for the patient as one which appears to him to be useless, the useful occupation should be prescribed for him. One danger exists in carrying out this general rule, a danger that is more frequent with depressed patients. This is, that slowness and inaccuracy in doing a simple useful task is sometimes more discouraging than an equal or greater degree of slowness and inaccuracy in doing an unaccustomed task or one that the patient considers to be useless. But this danger is usually more apparent than real. The advantages of demonstrating to the patient that he can be of use, and of increasing use, to himself and to the world far outweigh the possible danger. Not only should tasks be set that the patient can see are not futile, but a goal should be set toward which the patient should strive. He should be asked to try to do a little more than he thinks he can do; he should be made to realize that the accomplishment of this task is expected. On the other hand, to set the goal too far away is a discouragment. Each day's tasks should be complete in themselves as far as they can be made so. Much of the lack of success in getting patients

to weave rugs and to make raffia baskets is doubtless due to the fact that the completion of the task is a matter of weeks rather than of hours. What is accomplished must be apparent to the patient. The satisfaction of the instructor that he has been able to get a patient to perform a certain task is of less importance than the satisfaction of the patient that he has accomplished something. The patient's belief that he is improving is in most cases of far greater importance than the instructor's measurements. When interest wanes, the patient will complain that the task is too difficult, and will often give it up. Therapeutic exercises of a factory character are, therefore, of minor value. They have their place, and they hold a very important position at times, when the proper attitude has been formed, but they tend to retard or even to prevent the formation of the right attitude if they are begun too soon and if they are used too exclusively.

A patient must be taken away from the thought that the loss of a leg or the loss of its use has turned him into a thing of ridicule for the rest of his days. He must be educated to think of the day when he shall have gained a complete victory over his disability—when the paralyzed leg shall be "as good as new," or the orthopedic appliance that replaces his lost leg shall fit into his life, the life of a healthy, able-bodied man. But ridicule may be properly used, in small doses, to help the patient toward an optimistic and rational attitude toward his disability, and the fear or dislike of ridicule may be utilized to stimulate the patient to greater efforts. A much more difficult, but

nevertheless a very important, matter is that of getting patients who are or have been insane or who have some form of neurosis or psychosis to take a suitable attitude toward their eventual recovery and their return to normal social life. The complex of anticipated feelings of doubt of their own stability, of the possible ridicule of their neighbors, of shyness and of lack of initiative, is difficult to dispel.

A factor of the utmost importance in producing one kind of mental attitude in the patient is the kind of hospital in which he is placed for treatment. Knowledge that they are confined in an institution devoted to the care of incurable individuals is bound to have a depressing effect on many patients; if they are forced to live in the same wards in close association with these incurable persons the effect is worse. The institution which hopes to bring about rehabilitation should be an institution of hope. It should be one in which its function is expressed by the question, "What can we do for the patient?" This includes the whole physical, mental and social welfare of the individual. Its function is also to be expressed in the added questions: "What can we get the patient to do? What can the patient do for himself, what can he do for his family and what can he do for the community?" It is only an astigmatic, myopic, or perhaps an amblyopic, institution that will dare to ask: "What can the patient do for us?" In other words, the improvement and the care of its patient as the goal of the institution make for a more hopeful group of patients. Asylums for incurables, with their

emphasis on custodial care, may be needed for a few patients but they are more frequently relics of the dark ages. They deny the possibility of scientific advances and the patients are condemned to them to await dissolution.

So also perfunctory, indifferent men in the personnel of the institution—men that view their work with the patients as a "job" and seek only to perform their work with as little effort as possible—may destroy the morale of even a naturally hopeful, helpful patient. The hospital to which men in need of re-education are sent should be permeated with a spirit of hope. The instructors who have the greatest measure of responsibility for the recovery or non-recovery of the patients should be willing men capable of transmitting to their charges the optimism and hope they themselves must feel. And as a gloomy, dispirited personnel and hospital may retard or make impossible a recovery, so may good surroundings and helpful instructors hasten a cure.

The manner of finding incentives for recovery and producing the proper mental attitude in patients in the actual process of re-education is perhaps as variable as the combinations of individual characteristics of the patients. One man may desire to recover so he can marry; another may desire to get well so that he can support his parents; another may wish to return to his wife and children; another's chief interest may be his former occupation. There may be a combination of desires, and from whatever desires or desire are foremost the incentive may be developed.

A direct appeal to reason may suffice to change

into a helpful patient one type of disabled man. The patient may be told that the physician who said the paralyzed leg never would function properly again is not a specialist and knows little of these matters, and that the re-educator is a specialist, who does know the case thoroughly, and will soon have the leg in "working order." The specialist, or one who is reputed to be a specialist, has the best opportunity to cheer and encourage a disheartened patient. The specialist is consulted usually because other advisers do not know, or are believed not to know about the particular disease or injury. He comes to a patient with a created reputation of importance and knowledge and power, he is recognized as an expert, and the patient trusts and believes that benefit will result from the specialist's advice. Such a recognized authority can gain the attention and can create a new attitude. He can explain, and he will more frequently be believed, that the patient merely has lost a habit, and that he will be cured—that he will have the use of his paralyzed leg again—as soon as he has regained that habit through a course of treatment such as he is about to receive. Many a patient must be taken into the confidence of the physician and have his abnormalities explained. If a patient can be appealed to in this fashion he becomes of inestimable value in criticizing procedures, in suggesting new applications and in acting as a "cheerer up" of his less intelligent fellows.

Indeed, the process of re-education should never be begun with the patient mentally blindfolded. He must be made to coöperate with his

instructors, even though he may not be sufficiently intelligent to have his own case discussed thoroughly and even though he may not be able to recognize the reason for each exercise, game, occupation and other therapeutic measure. He must be encouraged by statements of his improvement. He must be shown in what ways the treatment he receives is improving his condition. If, as should always be done, accurate records of his performances are made, a statement of improvement becomes not only a matter of general feeling or belief that the proper results are being obtained. but there is the possibility of a real demonstration of improvement in speed, or in strength, or in extent or in accuracy of reaction. These records of performances will show at different times varying degrees of improvement and will also show differences in improvement of different functions, but the patient need not be permitted to fall into periods of depression due to the fact that his previous week's improvement is slight. These relatively level periods have their meaning and their lesson and they should be explained. It is essential to keep before the patient not only the need of absolute victory, but also the fact that he is approaching absolute victory. In short, the patient must be shown that he is being helped.

A patient may be made hopeful if he is told what others in his condition have accomplished. He may be told that other patients, in worse condition than he, have recovered and now are earning their own livings. "If they could do it, I can," he will say. A recovered individual may in many instances make a good instructor, not always in

a scientific way, but by way of example. The effect of having a recovered individual say to a patient, for example, "My arm was like that once; in six weeks I was all right," cannot be overestimated. This can be used as an occasion for the development of an incentive of competition—the patient sets himself up as as good a man as he who has been cured, and strives to make his recovery more rapid or more complete than that of the other individual.

Amusements and games are invaluable means of taking a patient's mind from his troubles and are remedies for depression. In the excitement of a game of baseball a paralyzed patient forgot the cane that had been his inseparable companion for nineteen years. After hitting the ball, without pausing to pick the cane from the ground he ran to first base in a successful attempt to "beat the throw." How little he realized what he had done is evidenced by the fact that after reaching the base he demanded his cane, saying he could not run without it. In the excitement of the moment the man forgot that he was paralyzed; he was thinking of the game, not of his own disability. The patient in need of re-education must think of things outside his disabilities, and amusements and games provide these things to think about. Employment of various kinds has a similar effect, as has been said above, but care must be taken to avoid types of employment that are likely to make the patient believe he is being treated as a child and will never be able to do a man's work.

Proper friendships between patients should be encouraged. Talking to his bosom friend, a man

is taken out of himself; a man in need of re-education forgets his disabilities and talks of his life before he was injured. Patients who are mutually congenial will talk of better days that have gone and which, they are sure, will return. They compare notes on their improvement. Each urges the other to exert himself toward the goal of absolute victory. They develop common interests and, therefore, subjects for conversation other than their disabilities. It is not good for the patient to be too much alone; he is too likely to dwell long and pessimistically on his troubles. Lack of acquaintances makes a man sullen and suspicious. The patient who feels no one is interested in him is likely to develop a state of mind in which he himself cares little whether or not he recovers. On the other hand, the feeling that other persons are watching him, hoping that he will be cured and expecting that he will regain his normal condition, is sure to produce an attitude of self-help.

It is well, therefore, to secure the coöperation of the patient's family and of his community. Relatives who only bemoan the fate of a man in need of re-education, who pity him and regard him as a helpless burden, place a real obstacle in the way of his recovery. The family which encourages its patient-member, which makes with him plans for the day when he shall be "recovered," which regards him as a potential asset instead of as a burden, and which coöperates with the instructors in charge of the patient, is a potent factor in the eventual recovery. Such a family circle develops a pride in the patient; it makes him feel certain

he is going to get well; it makes him desire to get well, so that he can once again take his place in it. The attitude of the community is perhaps equally important. The country and the community should look upon its disabled men as persons temporarily withdrawn from useful life but bound to return some day. It is now well recognized that returned soldiers in need of re-education should not be over-idolized; the community should let them know that it stands ready to give them the chance to become part of its life again, provided the patients make themselves fit. The community may recognize fully its debt to its disabled soldiers and civilians, but the method of paying that debt must be intelligently considered. There should not be a community attitude of willingness to assume the burden of supporting its disabled men, whether the disabilities result from war or from industry or from disease. The disabled man should be taught, if he has previously failed to learn this lesson, that he is one of the community, and that he as much as anyone else has a duty to perform. His duty, like that of his fellow men and women, is to do what he can, to strive to his utmost, to support himself and his family as well as he can, to uphold the State. In other words, his duty is the same as that of other good citizens.

PART II

GENERAL RE-EDUCATION PRINCIPLES

CHAPTER IV

THE FORMATION OF HABITS.

In the previous section the problems of re-education have been shown to be largely those of habit formation. Certain perverted habits must be replaced by habits which are more like those of the normal individuals in the community, and those habits which have been lost must be compensated for by newly formed habits. In general all habits are motor but for convenience it is possible to divide the habits into three classes, only one of which is called motor. The second kind is called sensory, and the third is called a delayed reaction habit. The motor habit can be briefly described as that reaction which invariably follows upon a given stimulus of one general character. The sensory habit may be defined as that reaction which follows a stimulus of a definite character when that stimulus is differentiated from other stimuli which have the same general character. The delayed reaction habit is one in which the motor activity does not immediately follow the stimulus but it is delayed. The delay may be a half a second or one second, and in certain cases it may be as long as a day or a week. These kind of habits can be exemplified best for our present purposes by the activities that we carry out in our daily lives.

The motor habit may be illustrated by those reactions which we execute in the processes of dressing and eating. In dressing, we pay little attention to the way in which the strings of our shoes are placed, that is we pay little attention to the direction and the amount of the strings projecting from the holes. We make the necessary adjustments immediately without having to judge consciously how much and in what direction the pull has to be made. In eating we do not consciously discriminate and bother with the visual differences in knives, one with a steel blade and one which is silver, or one with an ivory handle and one with a metal handle. We pick up the implement and use it regardless of how much it may differ from other knives which we have handled in the past.

In the sensory habit we have the process of discrimination which is the main factor. In daily life this kind of habit is best illustrated by certain social activities like those of meeting people in the street. As we walk about in a crowded section of the city we see hundreds, but when we meet a certain individual whom we have met before under certain circumstances we either lift our hats or we stop and shake hands. The visual stimulus of the individual has been discriminated from the visual stimuli of the other pedestrians, i. e., as being different from the visual stimuli of all of the other individuals whom we have seen.

The delayed reaction habit may be illustrated also by an activity which is common. That of letter writing is an excellent example. A letter is received in the morning, it is read but put on one

side because of a telephone call or in order to read other mail which has also been received. The original stimulus which we have received may lead to an appropriate reaction, a telephone call or a written reply, the day after or a week later, or perhaps no reaction of these kinds is called forth.

All three kinds of habits are utilized in the process of re-education. The needs are varied. The motor habits are those which we are concerned with largely in connection with the paralyses. The sensory habits are those with which we are concerned in the re-education of a tabetic. The delayed reaction habit comes to the fore as the important consideration in the re-education of the aphasic. In all of the neurological and psychiatric conditions with which we have to deal, we must produce or get formed habits of these three characters if the patients are to assume their positions in the social world.

In different individuals habits are formed with different degrees of difficulty. With some persons the time for the formation of an habitual kind of reaction to certain stimuli may be very short. With other individuals it may be relatively long. Some are able to form habits of considerable complexity with apparent ease. Others are able to form simple habits readily but those which are complex are formed with difficulty or not at all. At the same time it is also known that the total number of habits which an individual may acquire, and the general statement may be made that the number and the kinds of habits which may be acquired, is dependent upon the individual.

Although these statements apply to normal in-

dividuals, they are applicable equally and perhaps more forcibly to the abnormal who need re-education. In a few days the individual who is paralyzed may learn to flex and extend certain muscles or groups or segments, but for many weeks he may not be able to learn to utilize the combinations of activity towards the production of a purposeful movement. In connection with the practical application of procedures to bring about activities in abnormal individuals, it is helpful to keep in mind the facts regarding habit production in normal people. Much light is also thrown upon the process of learning in the abnormal if we take into account the facts regarding the formation of habits in animals. In animal psychology much attention has been directed to what has been called economy in learning. Some of the data obtained in the training of animals have almost direct bearing and application in our re-education procedure. Thus it has been found that the number and the frequency of the learning periods are important in the acquisition of a desired habit. When an animal is given one trial a day, it takes seventeen days, or in all seventeen trials, to learn to do the particular act thoroughly and almost reflexly. Another animal in the same situation given three trials a day has been found capable of learning it in nine days, or a total of twenty-seven trials. A third animal given five trials a day has learned to carry out the needed actions in eight days or a total of forty trials. A fourth animal that had been given one trial every other day acquired the habit in sixteen trials or a total of thirty-one days, while the fifth animal given one trial with free in-

tervals of two days learned in thirteen trials or a total of thirty-seven days. These facts have a direct bearing upon the determination of the course of the procedure in the re-education of abnormal cases. The same general laws apply. There is economy in learning up to a certain point. If we desire to have the individual acquire a habit, which we have set as a task, rapidly and with the least expenditure of time on his part, short re-education sessions followed by long free intervals are most advantageous. If we desire that this habit shall be acquired in the least number of days, more than one trial a day should be given. Anomalous though it may seem, it is true that rest periods apparently facilitate learning. James's well known dictum that we learn to swim in the winter and skate in the summer is borne out by all of the experimental results which have been obtained on the formation of habits. A certain amount of apparently resting time must be allowed the nervous system to become organized for the required adjustments. The complex nervous adjustments are made not only at the time a special exercise is taken, but also in the period of rest which follows one exercise and which precedes the next exercise. This has application to both normal people and to animals, and probably to a greater extent to those who need re-education. It is much better to give short periods of training with relatively long rest periods rather than to Keep a patient continuously at the re-education training as is so frequently done. To have a patient under training at the beginning of a series for not more than ten minutes at one time, and to

give him exercises twice daily with several hours' interval between the two periods, results in more benefit than a single period of exercise twenty to thirty minutes long at one time.

Over-enthusiasm is attempting to get a habit of a certain character formed may retard the recovery. Having the number of trials per day very large may even be harmful to the patient in that fatigue may be produced beyond that which is advisable. Another fact which we have learned from work on animals and on normal subjects which can be directly applied in our dealings with the abnormal is that habits may be inhibited by a number of mental and physical conditions. It has been my experience that in the patient needing re-education inhibitions are much more often produced. Great care to prevent untoward occurrences must therefore be taken in carrying out the re-education procedure. The mental attitude of the patient is of primary importance. So far as the instructor is concerned it must be appreciated that the attitude of the patient is determined largely by the attitude of instructor. If the patient thinks that nothing further can be done for him and by him two courses are open to the instructor. One thing is to do nothing further with the patient in an active manner, but to leave him to himself. However, the instructor should let him see what has been done for other patients. When this has been done it tends to put him in a mental state to demand that something shall be done for him. The other thing to do is to show the patient that something has been done for him, and by appeal to pride or self interest to get him

to believe and to insist that much more can and shall be accomplished.

The fear of pain, and the embarrassment which may be felt when other persons than the instructor are around, frequently bring about a disturbance or an inhibition of an activity which may have a deleterious effect upon the patient. When he discovers that under certain circumstances he is unable to carry out certain activities, he may develop the idea that under those circumstances the activities cannot be produced. He may, therefore, have a habit of inhibition. To prevent undue limitations and, therefore, disturbances, it has been my custom to permit the presence of anyone who is interested in the subject in the room while reeducation exercises are going on beyond those of an experimental character. This is done in order that the subject may not acquire a specific habit of reacting only to me as an essential part of the environment and not to others.

Care in manipulation will prevent many inhibitions which are due to the fear of pain. Frequently a rearrangement in procedure will also bring about the same results. That these inhibitions are normal phenomena and that the experiences are not isolated is illustrated in the attitude of one who is swimming but who has not become expert. If in swimming the arm strikes unexpectedly an object in the water, there is a tendency to lose a stroke or to make a complete readjustment of his body before proceeding. Or an extra wave which is unexpected and which flows over the head may result in a similar loss of adjustment. In the abnormal the disturbance of

an extra stimulus which is unexpected will sometimes bring about even a greater disturbance in activity than that which is found in the swimmer. It will frequently inhibit activity and carry it back to an earlier step of incompleteness.

CHAPTER V

MOVEMENT.

When we analyze any activity we find it to be complex. The movement is known to be composed of individual motor activities which can be looked at from at least three points of view. The activity can be dealt with in terms of contractions and relaxations of individual muscles or groups of muscles; or it may be analyzed into the elements of flexion, extension, and rotation; or we may deal with it in simpler terms of strength, and amount, and time, each of which is an element in accuracy. Since the combinations of muscles needed in special activities are detailed in many texts of anatomy, they will not be discussed here. We shall deal with movement from the standpoint which in clinical discussions is least frequently considered.

The movement can be judged from the standpoint of its strength or force. We may measure the strength in an absolute way, that is the maximum amount of strength which can be exerted, or we may measure the relative force, that is the maximum force of a muscle or muscle group in relation to other similar measurements of other groups or of single muscles. Secondly, we may consider the extent, or the length, or quantity, of

a movement, and this factor also may be dealt with in a corresponding fashion, total or relative. Thirdly, we may deal with the time of movement, and when considering the time we may measure two time elements or characters, either (1) the greatest speed of a single movement or the relative speed in relation to other movements; or (2) the rapidity with which an individual can execute successive movements, in other words, the speed with which one movement may follow another.

When we carefully examine a special movement of a purposeful character, we find that these three elements of strength, extent, and time are intimately related. When we speak of an accurate movement, we mean only that that movement has had a sufficient amount of force, a speed which is suitable for the movement, and an extent which carries the body or one or more of its parts as far as is necessary so that activity as a whole is properly carried out. In considering the activity of an individual we must, therefore, bear in mind that inaccuracies may be the result of variations in any one or in all of these three characters. At the same time in our re-education procedure we must bear in mind that a movement may be executed with sufficient force and sufficient strength, but so slowly as to make the activity as a whole futile or of no avail. Any one of the elements, or all of them, which is found to be deficient must be dealt with in re-education procedures and only by keeping them in mind can we attain those results of accuracy which are the end to be desired.

EXTENT OF MOVEMENT

In the past relatively little attention has been paid to this aspect of movement. Clinical studies, especially those with poliomyelitis patients, have dealt largely with strength tests, and the obvious purpose in much of the work has been to deal with recovery as if it were mainly that concerned with sufficient force of the muscles. It should be obvious, however, that this is only one of the elements. When we examine a part of the body in action we see that the extent of any movement can be looked at in terms of inches or feet or millimeters through which the part moves. But a brief consideration of some of the attendant conditions will serve to show that such a measurement is not accurate for many of our purposes, because if we desire to make comparisons of individuals we find that the lengths of the bones and of the connecting muscles differ. These differences necessarily affect the extent of movement if it be measured at the extreme end of the part in question. At the same time we must realize that in a compound segment, such as the arm or leg, the measurement of movement at one joint is bound to be affected by the mobility of all the sections. Some measures should therefore be taken that will be comparable for all cases and for the different parts of the same individual. The measure which appears to be the best for this purpose is the determination of the extent of movement in terms of rotation about the joints. All movements about joints are rotations, and it is this that should be taken for

comparison. This is not the place to enter into details regarding the anatomical characters of the joints, or the physiology of movements which may be produced at these points. It is sufficient to know that whether the point be of the ball-and-socket type or of the hinge type, whether it be of a small or large size, measurement which will be sufficiently accurate can be made by the use of apparatus which measures circular degrees. Ap-

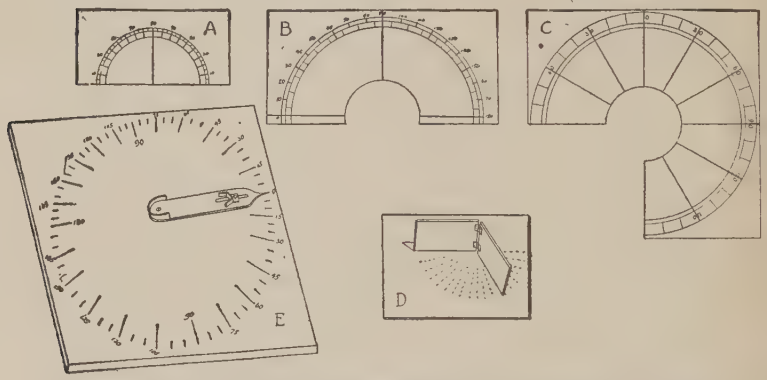

FIGURE 1. A, B, and C are three simple protractors for general use. D and E show two other forms of protractors, useful for measurement respectively of foot rotation and wrist flexion and extension.

paratus of this kind is readily devised in any laboratory or office.

The type of apparatus which should be generally used is a protractor. Because of differences in ease of application several are needed for the examination of the body. They may be made large or small, cardboard or wood or metal, simple or elaborate. Some are illustrated herewith. Those for measuring movements at the hip or at

the shoulder must be larger, those which are used for the estimation of finger movements must be small, and others for determining the amounts of movements at the ankle and the wrist must be medium in size.

In making a protractor for movement measurement methods of use must be kept in mind. In one the center of the protractor may be placed in front of or behind the supposed center of the angle or at least near the point of rotation of the joint and the movement measured in terms of the circular degrees through which the part is moved. In other cases there can be fitted to the part, the movement of which we desire to measure, a hinged piece of material so arranged that the arm or finger, for example, moves one of the parts, while the other remains stationary. This forces the hinged apparatus into an angle and the protractor reading can then be made from the position of its two parts.

In the measurement of the extent of movements of different individuals, both normal and abnormal, I have found three defects in the use of the apparatus, all of which prevent absolutely correct measurements. One of these is that the supposed center of rotation at a joint may be determined only after many careful measurements and an inordinate waste of time, or it is guessed at with a large error. The second difficulty is that in all the joints which I have measured the center of rotation is not a fixed point, but in every case the axis of rotation shifts. The location of the center differs, therefore, according to the quantity or extent of movement executed up to a certain an-

gular measure. I have also found, thirdly, that careful estimations of consecutive movements of the fullest extent in the same individual will vary

FIGURE 2. Showing the application of protractors to the measurement of movements at the shoulder and at the elbow. From McKenzie.

by as much as 5 degrees in either direction. Errors of this last kind may be partly due to the difficulty, or inability, to determine the approxi-

mate center of rotation or they may be due to an actual difference in activity of the individual from time to time. In the measurements which I have recorded I have considered that an accuracy to five circular degrees is quite sufficient. If in a

FIGURE 3. Showing the use of a small protractor for the measurement of finger flexion and extension. From McKenzie.

pathological case we can not discover that a supposed abnormality has greater variation than five degrees from the normal, we need pay little attention to it, and we may doubt that it is an abnormality.

The protractor may also be used for measuring

the accuracy of the extent of movement for certain special activities. An individual may be able to make a movement of a certain character. Regardless, however, of the fact that this movement may be less or greater than the normal, in some cases it is of considerable importance to determine the individual variations in this movement. Thus, it is useful to know whether or not a patient can repeat a certain movement once or oftener, and if so with what degree of accuracy. This is frequently of more service than it is to determine whether or not an individual can make a movement of a maximum and normal extent. From numerous experiments on normal individuals it is known that the accuracy of successive movements should be not far from ninety-five per cent, which means that a second movement following the first should vary from the first by not more than five per cent in either direction, less or greater.

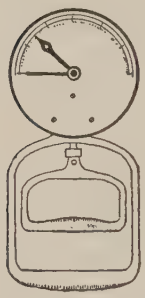

FIGURE 4. Hand dynamometer for testing and exercising the handgrip (flexion of hand and fingers).

STRENGTH OF MOVEMENT

Various means have been devised for measuring the strength of movement. The ergograph in its various forms can be adapted to certain muscle groups, although in the form most widely in use it is employed for measuring the strength of flexors, of the fingers, and sometimes of the wrist or the forearm. Oval spring dyna-

mometers have also been on the market for measuring the strength of groups of flexors, such as one gets in the grip, others for the strength of back movements or for the adduction muscles at the shoulder, etc. These instruments measure, or are supposed to measure, the absolute force of the muscles used in the movement.

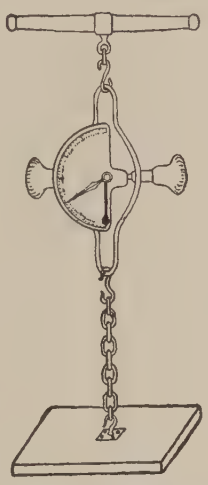

FIGURE 5. Combined dynamometer for tests and exercises. As shown the dynamometer is used to test the muscles of the back. The subject stands on the foot board and holds to the handle. When separated from the handle and the foot board chain the dynamometer can be used for measurement of adduction movements of the shoulders.

All of them have a place in the measurement of the strength of movements of certain patients or groups of patients, but another method more recently introduced for the measurement of any individual muscle group is of greater value. This is the spring dynamometer testing method of Martin and Lovett, who appear to be the first to use the method in connection with the examination of cases of poliomyelitis. For testing the strength of all the usual groupings of muscles, from four to six dynamometers of different tensions are needed. These range from the small and relatively weak dynamometer useful for determining the strength of individual fingers and toes to that for testing the large back muscles. The former pulls only as high as

5 kilograms while the latter must show readings as high as a hundred and fifty kilograms.

The method of using these instruments is quite simple but at the same time it requires some technical experience and skill. If it be desired to test the strength of the flexors of the forearm, a loose strap is placed about the wrist at a definite distance from the bend of the elbow or from the olecranon, or level with the exterior processes of the ulna and the radius. One of the dynamometers is locked into the strap at the outside surface. The patient is then required to contract the flexor of the forearm as strongly as possible while the operator holds or exerts traction upon the dynamometer. At the point where the dynamometer just compensates or corresponds with the strength of the muscle, a reading is made. This point is to be more justly determined by placing one hand on the contracting muscle or muscles and noting the point at which the muscles just begin to give against the force exerted by the operator through the dynamometer. It will be appreciated that when the more accurate measurements are to be made they can best be carried out with the aid of a skilled assistant.

Any group of muscles may be investigated in this manner but care must be taken in carrying out the procedure that the tests are made in such a fashion that the strength of certain muscle groups are determined. If the examiner is careful in palpating the contracting muscles he will often find that unusual combinations, or groups in which accessory muscles are brought into play, are not infrequently acting together to compensate

for a recognized defect. What may take place at times in a movement is well brought out in the study of muscle combinations by Beevor. Beevor has shown conclusively that different combinations of muscles may be used for the performance of apparently the same act. This has been confirmed by all others who have carefully examined muscle groups in action. It has been found, for example, that a certain movement is usually produced by the activities of two or more muscles working together. When resistance to the movement is interposed additional muscles come into play, and when the desired movement as a movement cannot be made (as for example, when the work to be performed is too great for the muscle group) there are sometimes brought into play, and most actively, other accessory muscles. This is also known to be the case in the production of extensive movements. A casual examination of an individual in the execution of a movement which is at the limit of his capability will serve to demonstrate this difference. If, for example, a patient or a normal individual be requested to adduct the arm as far as possible, the arm is raised from its normal position at the side of the body as far as may be by the shoulder girdle muscles, but to raise the hand and the arm to an even greater degree there come into play many of the trunk muscles and sometimes the muscles of the leg.

There is given herewith a table showing the comparative strengths of various muscle groups which have been determined by Martin and others in their study of this subject. This table will be found to be useful in estimating the degree of in-

volvement and the extent of recovery in cases of poliomyelitis as well as in other forms of paralysis.

TABLE I.

Showing relations between strengths of muscle groups and body weight. The figures in the table are to be multiplied by the body weight, the products being the average strengths of the muscle groups. Adapted from the data of Lovett, Martin, Mosher and Rich.

		5-7 years		8-12 years		13-18 years		adult
		M	F	M	F	M	F	M
Foot	Plantar Flexion	1.50	1.37	1.85	1.67	1.85	1.67	1.99
	Dorsal Flexion	.67	.60	.62	.56	.64	.58	.57
	Inversion	.41	.37	.39	.35	.42	.38	.38
	Eversion	.39	.35	.37	.33	.40	.36	.36
Thigh	Adduction	.32	.29	.30	.27	.31	.28	.30
	Abduction	.30	.27	.29	.26	.30	.27	.28
	Extension	.63	.57	.61	.55	.60	.54	.74
	Flexion	.67	.60	.64	.58	.62	.56	.64
Knee	Extension	.70	.63	.64	.58	.66	.59	.66
	Flexion	.36	.32	.34	.31	.34	.31	.35
Shoulder	Pectoralis	.44	.40	.42	.38	.42	.38	.47
	Latissimus Dorsi	.29	.26	.30	.27	.29	.26	.34
	Anterior Deltoid	.40	.36	.40	.36	.40	.36	.42
	Posterior Deltoid	.29	.26	.29	.26	.30	.27	.28
Forearm	Extension	.39	.35	.35	.32	.32	.29	.30
	Flexion	.52	.47	.51	.46	.50	.45	.45
Wrist	Extension	.25	.23	.25	.23	.27	.24	.21
	Flexion	.45	.41	.43	.39	.38	.34	.27
Thumb	Adduction	.31	.28	.30	.27	.28	.25	.26
Fingers	Extension	.14	.13	.14	.13	.14	.13	.13
	Flexion	.55	.50	.55	.50	.55	.50	.59

TIME OF MOVEMENT

The accurate measurement of the time of an individual movement (that is the time elapsing between the signal for the beginning of a movement until it is fulfilled or until the part returns to its normal position or comes to rest) is tedious and requires a large amount of special apparatus which is not always available, and which can be used only after considerable practice. Each of the time elements in a single movement may be

measured separately without much difficulty, although for most clinical purposes any value in these measures is not at present known. The measurement of an activity in this way is, we know, not very important in re-education. It is of some interest and also doubtless of importance that the latent period of a movement be not too greatly prolonged, and that the period of muscle shortening be reasonably quick, but these are elements in a total activity which can be dealt with for our purpose as a whole. In abnormal individuals we are concerned more with the execution of a movement rapidly which is followed by another movement, and then by a third and fourth, etc. In other words, we are more concerned with the speed of repeated movements or with the change in direction of a movement, than with the absolute speed of the individual movement. A modification of this statement may be made to the extent that the latent period of a movement, that period which exists between the time of the stimulus and the beginning of the movement, is of considerable importance to us because if the beginning of a movement be too greatly delayed the movement is ineffective. Since, however, we are chiefly concerned with the ability to carry out a movement as a whole, the reaction time, or latent period, can be estimated along with the other parts of the movement.

Two or three simple experiments are useful in determining the speed of movements.[1] If the

[1] These have already been described in my *Handbook of Mental Examinations Methods* (2nd edit., The Macmillan Co., 1919) to which reference should be made, but for convenience will be briefly repeated here.

patient is able to carry out a fairly complex movement such as the circular movement of the hand, the determination of speed may be made by using a simple apparatus consisting of a piece of wood in which a circular track or groove has been cut. The patient is directed to place the point of a pencil or stylus in the groove and beginning at a given signal to run the pencil continually around the track until he is ordered to stop. The two directions of movement, clockwise and counter-clockwise, may be tested. Knowing the length of the track and the number of revolutions one can then estimate the speed from the total extent. For many parts of the body such a test is not applicable, but another measure of the speed of movement may be obtained by determining the rapidity with which one movement follows another as in the process of tapping. In this test all that is needed is a pencil or a stylus which the patient uses upon a surface that resounds. For most patients needing re-education the number of "taps" can be counted, and by the simultaneous use of a stop watch the speed can be calculated. With intelligent individuals who are ambitious and able to coöperate, one can get a limitation of the muscular activity to a certain joint, and if the number of taps is counted for a period of five seconds there is sufficient determination of the speed. Comparison may be then made between activities at different joints.

When it is possible to use a pencil and paper, the taps may be made permanent records, and at a subsequent time they can be counted and compared with later performances. The speed of

tapping movements is so great for some segments in normal individuals that it is not possible to count them as they are being made, and it is necessary to have a permanent record which can subsequently be counted. Since we may have to compare normal with abnormal people, a normal part with an abnormal part, it is advantageous so far as possible to utilize the pencil method especially if the speed of the repeated movements exceeds four taps per second. These tests can also be carried out with a metal stylus, a metal plate, an electrical counter, and necessary batteries, but these are unnecessary laboratory refinements.

ACCURACY OF MOVEMENT

Although a movement is made accurate entirely by the combination of appropriate strength, extent, and time, accuracy is our primary goal in re-education, as well as in all education. If the individual has sufficient strength, and if he has the capability of making a movement to the greatest extent or to the slightest degree, as may be demanded, and if he is quick or slow enough in executing a movement at command, the three elements are normally carried out simultaneously in such a manner that the movement is called accurate. When the attention of the subject is entirely directed to one of the elements, as for example the extent of the movement, the movement in that particular may be normal, but if the other elements are examined we not infrequently find that they suffer at the expense of the one to which

attention is directed. This means that the movement is not accurate. Its accuracy is lessened because of the failure to attend to the goal of the movement so that all of the elements are combined into one whole.

In many re-education cases it is essential that special exercises be directed towards increase of strength, or towards increasing the speed or the extent, of certain movements. In most cases, and in cases such as locomotor ataxia this is sometimes exclusively the case, the re-education procedure should be directed primarily and at times entirely towards producing the movement as a whole, i.e., an accurate movement. Moreover we know that in certain cases (for example, those with disease of the cerebellum) the individual elements in the movements may be perfectly normal but they may not be suitably combined. This produces an inaccuracy which it must be our effort to replace by an accurate activity.

The control of movement is generally believed to be brought about by the use of certain sensory elements. Afferent impulses of the nature of sensations are initiated whenever a movement is begun. These arise through end organs in the skin, in the muscles and tendons, and perhaps in the bones. When a movement takes place the end organs are stimulated so that impulses are sent towards the central nervous system. In some manner these afferent impulses exert a control upon the outgoing or the motor impulses so that the movement is graduated, or its parts are timed and harmonized. The neurological mechanism

whereby this control is accomplished is not understood, although there are many explanations that have been advanced to account for it. We know that in locomotor ataxia, in which the sense of position is very defective or is lost, the movements are inaccurately carried out, although the individual components of the movements may be normal—in strength, extent, and time. The loss or defect in the normal afferent apparatus is of the greatest importance in cases of this kind. It can be compensated for by other sensory elements and the direction of re-education must necessarily be towards the production of the normal combinations of speed, extent and force. The consideration of "combined" activity also holds in numerous other conditions with which we may have to deal. This is true, for example, in cases of paralysis agitans and of multiple sclerosis. In the paralyses due to spinal or cerebral injuries also, after a certain capability is attained, it is frequently more valuable to exercise the individual in the production of the movements in an accurate manner, and not to stress the components. This in a different field is also found to be the case in patients with so-called "motor" aphasia.

HELPFUL DEVICES IN RE-EDUCATION

Many devices may be brought into play to exercise parts of the body. They are best used in accordance with the needs and the mental attitude of the individual patient. Much will depend upon the ingenuity of the instructor. Here I

will mention only a few which have been useful in cases which have come under my observation, but it is emphasized that the individual

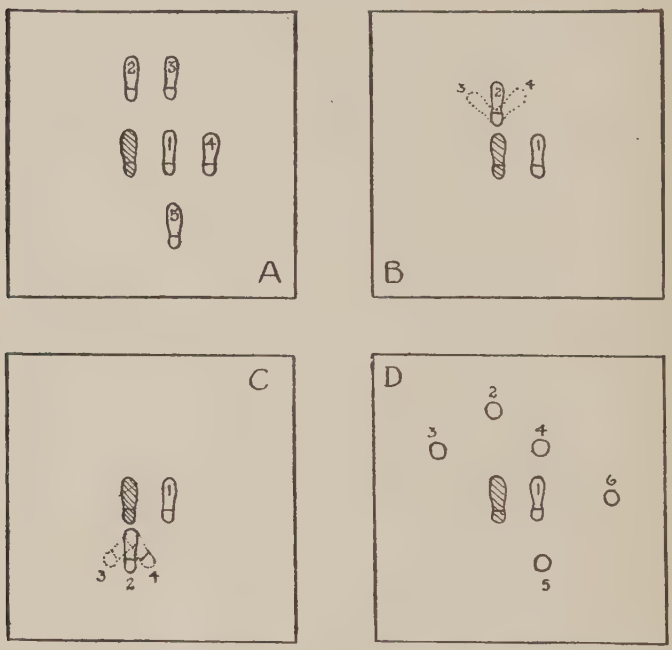

FIGURE 6. Four boards for exercise of foot movements. The normal foot is shown in shaded form. The original position of the paralyzed segment is shown as 1, and the successive positions with the higher numbers. In A the foot is firmly placed in each position. In B, the foot is rotated on the heel from 2—3—4. In C there is a similar rotation on the toe. In D successive toe positions are shown.

needs of the patient must be considered to be primary and must be attended to. Dependence, therefore, must not be entirely placed upon the devices which are here pictured and described,

for each patient is a separate problem which must be solved in accordance with his mental and physical condition.

In planning exercises for the leg, it is very desirable that attention be directed to getting the patient to control the distance and direction in which the foot is placed. The accompanying diagrams (Fig. 6 A, B, C, D,) show some of the means which have been used in exercising the right leg because of a partial paralysis. In these diagrams, which are drawn on heavy card-board for the patient, the positions of both feet are indicated, the left foot being shown with the crossed lines, and the successive position of the right foot by the unshaded diagrams. At the beginning of each exercise, the position of the right foot is shown at 1 and succeeding positions of the foot are indicated by subsequent numerals. In making these designs the distances from 1 to 2, or 3, or 4, or 5, must be adapted to the individual patient. Here it may be mentioned again that the demand on the patient for the accomplishment of something just beyond his capability, as determined by an examination, will usually bring forth a greater effort and will very frequently show that he is able to extend himself beyond the point that an examination indicated to be his limit.

Figure 6 A shows the simplest of these exercises. In this exercise the patient stands erect upon the spaces indicated, with the feet slightly apart but pointing directly ahead. From position 1 of the right foot, that foot without dragging the toe is moved to position 2, firmly planted there and the position held for a few seconds.

Then in a similar way the foot is raised from the floor and carried to position 3, then to 4, next to 5, and it is then returned to its original position at 1. In Figure 6 B the diagram shows an exercise for the rotation of the leg. The foot is first carried from position 1 to position 2 immediately in front of the left foot. Using the right heel as the rotation point, the foot is carried slowly around to 3, then to 4, and after returning to 2 it is lifted back to its original position at 1. A

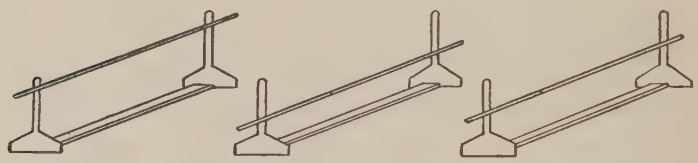

FIGURE 7. Low hurdles, useful in exercising subject in stepping movements. The cross bars are adjustable in height, and the distances between any two hurdles may be changed.

somewhat similar exercise is shown in figure 6 C in which, however, the paralyzed foot is placed behind the non-paralyzed, and in which the rotation takes place with the toe as a rotation point. In Figure 6 D an exercise similar to that shown in Figure 6 A is indicated. In this exercise the smaller circles indicate respectively the positions of the toe of the foot which is paralyzed, or of the heel. This exercise should be arranged to suit the individual patient both with respect to the location and the order of the position of points 2, 3, 4, 5, and 6.

Two special exercises for the control of the leg in improving the important movements in

stepping, are carried out with other special apparatus in addition to those in Figure 6. One of these exercises is performed with a series of so-called hurdles which are pictured in Figure 7. These hurdles are constructed individually and in such a fashion that the heights of the hurdle bars may be changed as occasion demands. The uprights should not be over 24 inches in height, and the distance between them need not be greater than 36 inches. Three or four of the hurdles are placed at different distances from one another and with the cross bars at different heights. An irregular arrangement is advised so that the patient must in each case adapt himself to a new condition, both in length of step and in height to which the paralyzed leg must be lifted. Figure 8 shows a similar hurdle constructed somewhat differently and for a slightly different purpose. This hurdle is a "high" hurdle with the uprights 42 inches high. The cross bar is a piece of twine which can be attached by a loop to one of the hooks on the upright A., and carried over to a corresponding hook on the side of the upright B. This twine is held taut by the weight C. The height of the twine can be ar-

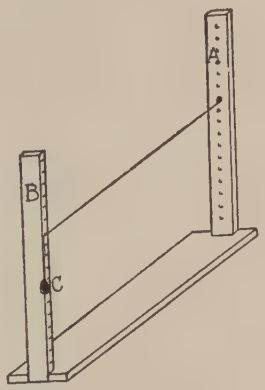

FIGURE 8. High stepping apparatus, for exercising subject in flexion and extension at hip. On the uprights, A and B, there are hooks permitting the raising or lowering of the twine bar.

ranged for the individual patient. The space between the uprights, A and B, should be so long that an awkwardness in moving the leg does not cause the patient to hit either of the uprights. I have used a space of about five feet between uprights. The hooks on A and B are placed at intervals of one inch. Performance on this apparatus can be used to show an improvement in the capability of the individual in that the "bar" of twine can be raised to determine the maximum height to which the leg can be lifted. For this purpose it is advisable to make at least three measurements and to average them.

In addition to the exercises which have been described with the use of specially constructed apparatus it is advantageous to utilize the normal activities of play as far as possible. This is especially true when two or more patients can be exercised simultaneously. Under these conditions resort is made to the competitive instinct which will help to stimulate the individuals in the direction of a maximum accomplishment. Thus I have been successful in getting groups of patients to run races. In exercising a group of two or more in this way, I have tested with a stop watch the apparent maximum performance of each patient, i.e., his speed to run a distance of about twenty to thirty yards. In order to bring into play the factor of competition, I have taken the records of individual accomplishment of two or more patients and handicapped the faster in accordance with the records which have been made. When the group race is run it has

usually been found that the time is shorter than that in the individual trials. It has been interesting to note that the handicaps can be so arranged that the contestants cross the finish line with very little distance between them. The exercise can also be used for individual competition by having the patient "run against" his own record. Improvement can, of course, be plotted by using the daily records or weekly averages.

In a similar fashion one can have competition between two or more individuals, or between an individual and his previous record, in the distance that a football can be kicked over a smooth surface such as a lawn. In carrying out this exercise, the round "association" football is better than the oval ball. For some patients, especially those who show foot drop, it may be necessary to "tee" the ball so that the toes can be placed under the ball.

Activities of the hand and arm are so varied that many more exercises can be devised for the practise of this segment than for the leg. In devising individual tests or exercises changes must be frequently made, adapting the exercises to individual patients who have peculiarities of defect. Besides the utilization of dynamometers which can be used as exercising instruments as well as for measuring purposes, almost any activity is worth attempting. When conditions have warranted I have not hesitated to ask a patient to play basebail, golf, volley ball, or any of the games which his physical conditions seemed to indicate that he was capable of accomplishing, at least in part. Most of the games can also be

used as a measuring rod for determining individual improvement, by applying certain rules to the exercise. As an example of this we may cite the apparently complex process of hammering ten nails into a piece of soft wood. This may be measured in the following manner. The "exercise" wood must be prepared by having ten nail holes started. This is done by driving ten nails through a piece of wood ⅛ inch thinner than the wood that is used for the test, and using this as a templet ten ⅛-inch holes are started. The patient places a nail in one of the shallow holes and using the hammer with the affected hand attempts to drive the nail home. The number of strokes needed to accomplish this can be recorded without difficulty, for each nail or for the ten. Improvement in accomplishment will be found in one or both of two directions. One of these is a decrease in the average number of strokes needed for each nail, and, second, a decrease in the number of inaccurate movements which are indicated by the bending of nails and by blows on the wood surrounding the place where the nail is placed. The procedure of making the nail holes is adopted so that it is easy for the patient to set them serially in the holes, and so that they are retained

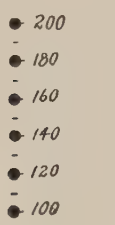

FIGURE 9. Marks on wall for measurement of reach (forward and abduction of the shoulder). Figures show heights in cm. from floor level.

without holding. The danger of having the patient's fingers mashed with the hammer is thus obviated.

Simpler tests and exercises, not however simple in the sense of accomplishment but in the sense of being directed to certain activities which can be carried out by the patients, are numerous. For the exercise of the shoulder segment I have placed upon a wall a number of diamonds or

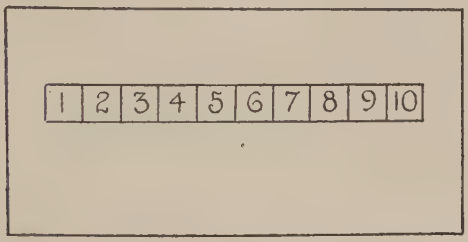

FIGURE 10. Apparatus for training on rapidity of successive movements, mainly of the arm. The smaller squares are pointed to serially, and repeated again and again during the time of the exercise.

circles or squares as shown in figure 9. They began at one meter from the floor and they were 20 cm. apart. The patient was directed to reach as high as he possibly could on this scale. The results of these exercises can be readily tabulated also. Of a similar character, but for movements of a different type, I have used a series of squares one inch to the side arranged in a line as shown in figure 10. The patient sitting at a table is directed to point his finger at the first square and with successive backward and forward movements to point to each of the succeeding squares

in the series of ten. After this has been accomplished, he is then to return to square 1 and to do the series over again and again, and to continue until the signal to stop has been given. A definite time, 15 to 30 seconds, is taken for this exercise and the total number of squares to which the patient has pointed during that time is recorded.

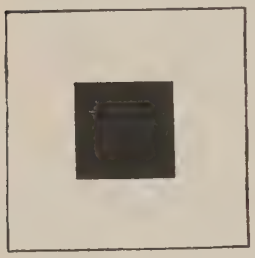

FIGURE 11. Apparatus for training in accuracy of hand and arm movements. The dark inner square is cut out and the subject is instructed to trace this square on a paper beneath.

A somewhat similar, although more complicated, exercise involving the use of all of the muscles of the arm segments, can be used when the patient is able to hold a pencil. When I have found this to be the case, I have started him tracing with the aid of a card-board die as shown in figure 11, from which the central square has been cut. The die is placed upon a piece of paper and held firmly by thumb tacks. The pencil is placed by the patient in one corner and carried around successively on the four sides. In the first re-education trials it will be found that the direction of the pencil is not well regulated. There are many unnecessary lines within the square and others which project outside upon the die, as well as short discontinuous lines indicating an irregularity in the movement. As the patient improves these evidences of irregular movement decrease in number and in extent. Although no absolute numerical value can be given to the ac-

complishment, as is the case in many other tests, a certain estimation can be made if a series of values is adopted and the comparison made from day to day, or from week to week. I have credited the individual with scores from one to five according to the obvious accuracy of his results. For a week I have calculated the average and have compared it with prior performances to determine whether or not, and how much, improvement has taken place. Another exercise of the same general character can be made by providing a rule with two marks indicating the beginning and the end of a line which it is desired to have the patient draw. The rule is shown in Figure 12. If the rule is made of the same length as the width of the paper upon which the lines are to be drawn it is a relatively simple matter to determine the accuracy or inaccuracy of beginning and ending at the points desired. These records may also be evaluated in the same manner as the tracing of the square.

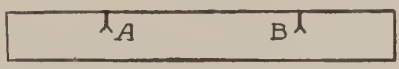

FIGURE 12. Apparatus for training in accuracy of drawing a line. The marks, A and B, show the beginning and ending of the movement. Several boards of this kind may be used with different positions of the starting and stopping marks.

In addition to these exercises in which mechanical aids are given to the patient, free-hand movements may be demanded. For examples: making straight lines, circles, squares, or other figures, and an extension of this in the making of letters of the alphabet or in letter writing. Others will suggest themselves as a patient's condition improves.

In many cases of paralysis, especially in those of a cerebral type, the movements of extension return much later than those of flexion and many special exercises must be used in order to bring out those capabilities or to exercise the patient in these operations.

A simple method which can be used is to provide for the patient a long rule or a long sheet of paper on which there are vertical lines at certain distances from each other, inches or centimeters, and which are numbered. The patient is instructed: (a) to place his thumb (we will take the right hand for example) at the extreme left of the ruled portion of the paper and to stretch as far as possible the forefinger from the thumb, (b) holding the forefinger in that position to stretch again with the medius finger, (c) holding the position with the middle finger to stretch with the ring finger and (d) holding that finger to stretch with the little finger. The total distance of the stretch from the thumb to the little finger is then recorded.

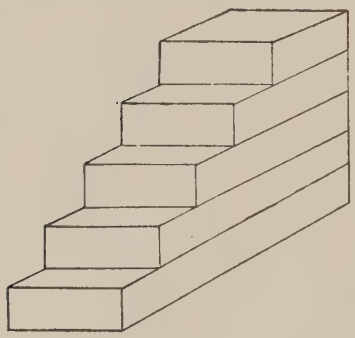

FIGURE 13. Finger stepping apparatus.

Another exercise for extension movements is provided by taking strips of wood about $\frac{7}{8}$ inch thick and arranging them like a stairway as shown in Figure 13. Placing the thumb upon the

lowest step, the forefinger is lifted to the second step, the medius finger to the third step, and-so-forth. This stairway may be constructed with a different height of step from that suggested, and at times it will be found advantageous to have at least three stairways, with steps ½, ⅞, and 2 inches in height.

An appliance to be used in a different type of exercise is illustrated in figure 14. This is essentially a milled nut (A) and a fine machine screw

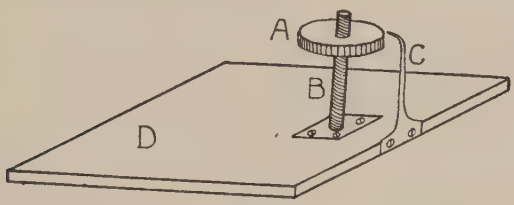

FIGURE 14. Apparatus for exercises on turning movements of the forefinger and thumb. A is a milled nut, which works on the fine thread B. C is a pointer, showing the amount of movement carried out. The head of the milled nut is graduated in ten degree divisions.

(B), so arranged as to permit easy counting or calculation of the revolution of the nut. The screw is put through a hole in a board (D), and close to the milled nut a projecting pointer (C) is arranged so that the rotations and partial rotations may be counted. The patient is instructed to take hold of the milled nut with the finger and thumb and to turn it, in accordance with directions, in a clockwise or counter-clockwise direction. The nut should first be set, it is almost needless to say, with its zero point indicated at (C). The patient is then requested to

make ten successive turns with the fingers, beginning a later turn at the point at which the former one left off. After the series has been completed a reading is made and from this there can be calculated the average extent of his turn.

Already mention has been made of the fact that a tapping test can be used for determining the speed of repeated movements (p. 70). This test may also be used to exercise the patient, and for this purpose it is advantageous to select a definite time for the performance, say 10, 20, or 30 seconds, and to have the taps recorded on paper and subsequently counted. With a patient who can give intelligent coöperation one can exercise him for movements at the wrist, and at the shoulder, or for combined movements.

When the patient becomes able to make opposing adjustments with his finger and thumb, I have used many tests so that his movements are improved. One of these is to provide him with weights which are to be lifted. These weights can best be constructed by using a bottle into which shot are placed for added weight. He is instructed to lift the bottle to a height of about six inches and replace it upon the table. This exercise is carried out with the thumb and each of the fingers in succession. To make the test more difficult after it has been found to be easy for him, I have oiled the bottle or covered it with soapsuds in order that he may be compelled to grip it more firmly and to take special care in the performance of the exercise.

Another test and exercise which can be given is with shot or steel balls of different diameters,

or with large and small marbles. I have used steel balls ½ inch and ⅛ inch, and shot about 1/32 inch in diameter. Ten of one kind are placed on the table in front of the patient, with not less than two inches separating the individual balls. The patient is instructed that at a given signal he is to pick up the balls, one at a time, and to deposit them in a box which may be placed either to the right or to the left. The time for the performance of this is recorded. After a few days or weeks it may be found that all the expected improvement in the picking up of the larger balls has taken place, and from that time the exercises should be given with the smaller balls or with the shot.

Mention might also be made of many other exercises which have the character of normal sport. Only two will be briefly described here, but the number that can be used will depend upon the instructor and his pupil.

One test of this kind is to place a waste paper basket in the corner of the room, and near the patient to provide another basket containing tennis balls. Standing at a distance of about three yards he throws the balls into the basket if he can. His score is the number of successful trials which he makes. A refinement in calculation can be made if one desires to do so by giving a small credit for those attempts in which the basket has been hit, but in which the ball has not gone into it, and greater credit for fully successful attempts.

A second exercise of the same general nature which, however, is much better as far as deter-

mining improvement, or when the improvement has reached a certain point, is that in which the basket is replaced by a target as shown in Figure 15. The inner circle of the target is made with a radius of four inches, the middle circle with an eight-inch radius, and the outer circle with a twelve-inch radius, all being placed on a sheet of card board which is thirty-two inches square. The score value for each part of the target is inversely proportional to the approximate area covered by the part. The patient attempts to hit the inner circle which has the value of ten. The score for ten trials is taken. The target may be placed at different distances in accordance with the abilities of the patient, and it can either be hung on the wall or it can be placed upon the floor. In order to avoid mistakes in the determining of the points at which a ball has struck, I have used the device of having the balls lightly covered with talcum powder or with powdered chalk so that when a ball strikes any part of the target it leaves its mark. In this way a score may be calculated after the completion of the ten throws, or at the later convenience of the instructor. The marks

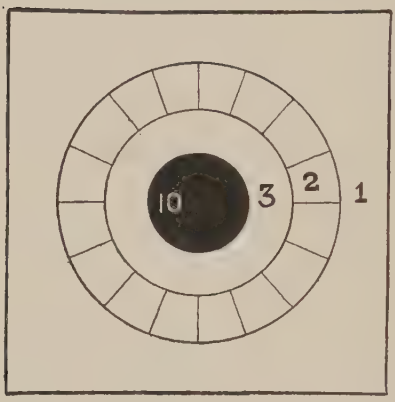

FIGURE 15. Target for ball throwing, showing values given for hits.

are readily removed with a damp cloth and the target made ready for a later test.

Several other illustrations are appended of appliances used for special exercises, but the descriptions give sufficient detail of their use.

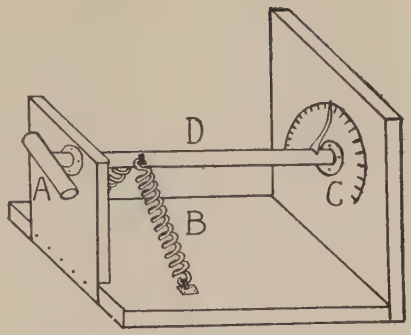

FIGURE 16. Apparatus for testing and exercising pronation and supination of arm. A is handle which is grasped by the subject; B, a spring which is extended during pronation (another spring for supination is hidden behind the front); C is a scale for reading the amount and strength of the movement. When the extent of movement is to be measured the springs are replaced by weak rubber bands.

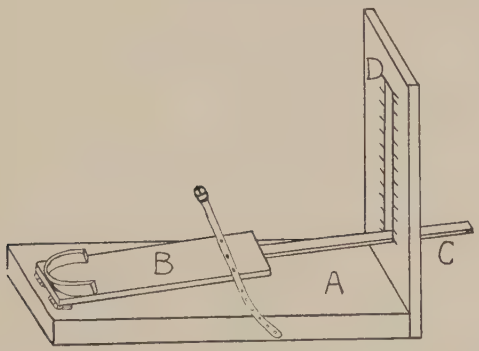

FIGURE 17. Apparatus for estimating amount of movement of, and for exercising, the foot in lifting from the heel. Especially useful in foot drop and similar conditions. To the end of the foot bar, C, there may be applied springs or weights. B is a foot rest to which the foot is strapped. D is a scale constructed to show circular degrees of movement.

CHAPTER VI

GENERAL RE-EDUCATION METHODS.

Every means that can be used to bring about a rehabilitation of the individual can be called re-education. Many of the methods are not distinctly re-educational, but are applicable to many classes who need physical restoration. It should, however, be understood that re-education is not to be looked at from a narrow point of view, and that psychological procedures and chemicals may find their places in the eventual recovery of the patients. The immediately applicable methods are those that are usually grouped under the names electrotherapy, hydrotherapy, and physiotherapy. For full accounts of the values, applications and limitations of the numerous forms of electrotherapy and hydrotherapy the reader is referred to the numerous books dealing with those subjects. Here only the briefest mention can be made of them.[1]

Electricity is now used in different forms. Magnetism appears to have no value. The value of the galvanic battery in the stimulation of muscles and nerves is probably very slight. It has value in the diagnosis or determination of degeneration in the peripheral neuro-muscular ap-

[1] Reference may conveniently be made to McKenzie's *Reclaiming the Maimed* (The Macmillan Co., 1918), pp. 10-104.

paratus. The faradic, or induced current is of importance for the stimulation of muscles and nerves, as well as for diagnosis. The rapidly repeated induced current stimulates the striated skeletal muscles, and throws them into contraction during the time of its application, and in this respect differs from the galvanic current which brings about contractions only at make and at break. Currents of high frequency, having large force or voltage, but low intensity or amperage, produce little visible change in the motor activities, but they may have value by reason of certain general physiological effects. A current of this kind produces heat by reason of the resistance of the tissues through which it passes, and it increase the blood supply. It may, therefore, be a valuable adjunct or a preliminary to the passive and active exercises which are carried out. Static electricity has also more general effects, although the single spark may be helpful in individual relief for spasm.

Radiant light and heat act in a general way and have their main values in their soothing effects as well as by the production of hyperemia, which may be local or general. In the form of stupes and hot packs heat is allied to hydrotherapy.

Under the heading hydrotherapy there are grouped all procedures in which water is applied to the body, except internally. There are many kinds of baths:—hot; cold; alternating; medicated; immersion, local and general; and douche. The main value of each kind lies in the general change which takes place in the part to which it

is applied, especially because of the changes in the blood supply.

All of the general methods enumerated above are in reality parts of physiotherapy, but the latter term is most frequently applied to those kinds of treatments which are sometimes called mechanotherapy or, more properly, kinesotherapy. The different forms of kinesotherapy are the most

FIGURE 18. Showing how passive movements of the ankle are to be made. From McKenzie.

important of the physiotherapeutic measures, but they are not widely understood. They have lately been used by many who have thought them too simple to study. They are not spectacular, because they are carried out without the use of brass knobs and handles and immaculately white porcelain or black paint. There are two main forms of kinesotherapy—active movement and passive movement. Active movements may be (a) free or (b) resisted. Passive exercise is of two kinds. One is the change in the spatial re-

lations of parts of the body brought about by the operator. Functional elements are manipulated in a manner to resemble active movements. Thus, the forearm may be moved in any or all of its possible directions. This is usually called passive exercise. The second kind is commonly

FIGURE 19. Showing how "effleurage" is carried out on the arm. From McKenzie.

known as massage, which is another kind of manipulation of parts of the body. This is mainly a method of dealing with individual muscles or parts of muscles, less frequently of muscle groups which are associated with normal bodily activities.

Passive exercise in the restricted sense need not detain us. It is important, however, to recognize that different effects are produced by the

slow and the quick movements, and that this method of exercise may be advantageously combined with free exercises. The method is of greatest use in those instances in which there are limitations of movement, as in stiff joints and in partial paralyses.

Massage, which is the other form of passive

FIGURE 20. Showing how the muscles are kneaded in the process called "petrissage." From McKenzie.

exercise, is carried out in three different ways, each of which has its own special value. For the purpose of soothing the patient as well as reducing voluntary effort and involuntary contractions, the part is gently stroked from the more peripheral part towards the heart. This is technically known as effleurage. It is efficacious in reducing spasm-like conditions, and it also reduces tremor. Gentle application for a few minutes will help to reduce a tightly contracted

muscle. When stronger pressure is exerted it increases the circulation and when given strongly over the abdomen it may increase the activity of the smooth muscles of the intestines. Effleurage, especially when the stronger pressures are used, develops into a kneading like process, but when this point is reached it is called petrissage. Pet-

FIGURE 21. Showing the movements in the hacking of the muscles. This process is called "tapotement." From McKenzie.

rissage is a kneading of the tissue beneath the skin, the skin itself moving with the operator's fingers and thumb as the underlying tissues are grasped and rubbed. This process squeezes from the tissues the venous blood and the lymph, and permits the freer entrance of the arterial blood. It helps to break up adhesions. When performed properly it is generally soothing to the subject. The third process is the rapid mechanical stimulation of tissues by blows. This is called tapotement. It

may be weak or strong, and may best be carried out by striking with the ulnar borders of the hands alternately, while the operator's wrists and fingers are relaxed and act like flails. Depending upon the strength of the stimulation, it may act principally upon the skin or upon the tissues beneath. It is most valuable as a stimulant to muscles, the irritability of which is greatly increased after several applications. A more rapid and slighter blow may be given to tissues by the use of the medius finger which is rapidly moved to and fro in a rhythm like a tremor. This resembles the vibrations which are given by many mechanical appliances. When applied over the point of entrance of the nerve to a muscle it is very stimulating, and it may result in a clonic activity.

In the application of massage the general rule regarding all exercise should be followed. The first period should not be longer than a minute or two on any one part. If the number of parts to be dealt with is great, the whole time of treatment may be as long as a half hour, but it is seldom necessary to continue beyond that point. Masseurs who give all patients a treatment for an hour do not treat the patient, but rather "put in time." In many cases the total time for treatment should not exceed fifteen minutes, but the time should be regulated in accordance with the physiological state of the tissues, and it bears a relation to the number of parts that require treatment. Too much massage like any other exercise has a tendency to produce muscle fatigue. Fatigue diminishes the tonicity of the muscles

and, when long continued in a muscle which is already weakened, it may produce a functional loss which corresponds with a complete paralysis. Passive exercise of the nature of massage is in all respects much better than mechanical means of exercise, such as that produced by an electrically driven vibrator, unless in the use of the mechanical appliances the treatment is interrupted or is accompanied by careful manipulation or palpation of the muscles to determine the effect.

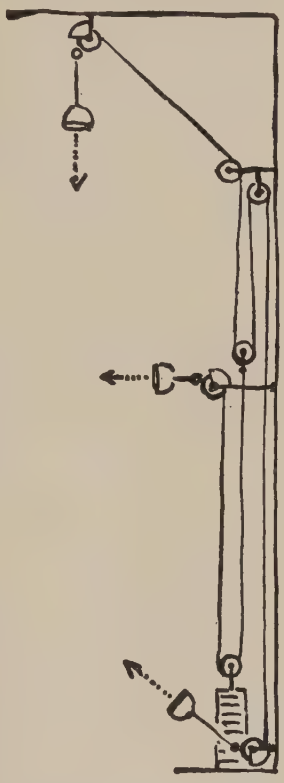

FIGURE 22. Gymnasium apparatus, useful for exercises of parts of body; see especially Figs. 23 to 37. From McKenzie.

Although the passive exercises (by massage, accompanying electrical stimulation, or with mechanical appliances) have their value, they are preparatory to, but cannot assume the place of, exercises that are active on the patient's part. The active exercises are usually classed into those that are free and those that are made against resistance. However, all active so-called "free" movements are made against the resistance of the weight of the part moved unless the part is carefully counterbalanced. The quan-

tity of resistance may be altered, and when resistance beyond that of moving the special segment is encountered the movement is called a resisted movement. Exercises of these characters are carried out in two ways. The first of these is that in which the patient executes the movement at command, this movement being free and not concerned with the overcoming of much resistance beyond that of lifting the parts of the body. The second is that in which the movements are resisted in one way or another, this resistance

FIGURES 23 and 24. Exercises for flexion and extension of forearm with gymnasium apparatus (Fig. 22). From McKenzie.

FIGURES 25, 26, and 27. Exercises for shoulder rotation, flexion and extension of shoulder. From McKenzie.

being applied either by the re-educator or by some other, usually mechanical, means. Here also the same warning may be given that the utilization of mechanical contrivances which resist the activities of the patient are much less effective in bringing about the desired results than the hand manipulation of the instructor, who can control his activities in relation to the defects which exist and in relation to the intensity of these defects at different

times and in different parts of a movement. At the beginning of many series of exercises in which the activity of the patient is being opposed by that of the instructor, the resistance which

FIGURES 28, 29, 30, and 31. Exercises for adduction and abduction of the shoulder. From McKenzie.

FIGURES 32, 33, and 34. Exercises with gymnasium apparatus for flexion and extension of knee, and adduction and abduction of the hip. From McKenzie.

FIGURES 35, 36, and 37. Exercises for abduction of hip, hip flexion and extension. From McKenzie.

should be encountered by the patient should at first be very slight. The resistance should be little or nothing until the subject has learned that he is capable of carrying out the particular movement by himself. In succeeding exercises the opposing resistance should be increased but it

should not go to the point that the individual is unable to overcome the resistance. One reason for this is mental. The patient is to be encouraged. Another reason is to be understood from those studies of muscle activity which have been carried out by Beevor, Duchenne and others. They have demonstrated clearly that when the activity of a group of muscles is not sufficient to overcome an outside resistance, there will be brought into play many other accessory muscles, beyond those which are usually involved in that special movement. In the paralyses and other motor defects it is usually more important to get the individual to recognize his ability,

FIGURES 38, 39, and 40. Exercises for passive abduction of the shoulder. From McKenzie.

FIGURES 41, 42, 43, and 44. Free exercises in dancing step. From McKenzie.

FIGURES 45, 46, 47, and 48. Free movements in dancing steps. From McKenzie.

FIGURES 49, 50, 51, and 52. Free movement in dancing steps. From McKenzie.

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or to improve his ability to carry out movements of a normal character in which certain combinations of muscles are normally used. It is, therefore, important that the individual should not be encouraged to bring into play those accessory muscles which can be used by the patient, but which the re-educator does not wish the patient to depend upon. If the resistance is too great

FIGURES 53, 54, 55, 56, 57, and 58. Free movements using a medicine ball. From McKenzie.

the tendency is to make use of the more usable muscles, to the exclusion of those muscles which should be normally used.

At the beginning of re-education, variability in activity is the rule and not the exception. In the re-education of a paralytic, which we may take as an example, it is most frequent to find the subject is capable at one time of executing a movement of a certain kind, to a certain degree, with a certain strength, with a certain speed. The next time the subject attempts to make the movement there may be a very considerable exaggeration in one or in all of these characteristics or there may be a considerable diminution. This variability, however, is one which diminishes as re-education progresses. It may not be found after the first few weeks of training, unless embarrassment or emotional upsets intervene. At any time the pa-

tient may again show great variations in capability but these are most frequently due to his mental state.

The quantity of exercise which a patient may take is to be measured essentially by the effect that the exercise has. A certain amount of fatigue in these abnormal individuals is no worse than it is for normal people, but it should be kept in mind that in general fatigue ensues much more suddenly in abnormal conditions than in the normal. Between individual movements a rest should always be taken, even though this rest may only be in terms of quarter seconds. If, however, in the execution of a second movement it is found that this movement is markedly decreased in extent, or force, or time, as compared with the same movement which has just been executed, it may be taken as an indication that the neuro-muscular apparatus, or the subject as a whole, is fatigued. It may be that the period of rest between the two movements has not been sufficient to permit the normal amount of recovery. In general the dictum may be laid down that the patient's second movement should be the equivalent of the first and that in a series the later movements should not at any time differ from the first by more than ten per cent. This, it must be understood, applies primarily to those cases in which the re-education exercises have been in progress for some time, when the patient has shown his capability to carry out his exercises in a regular, routine manner.

The accessory apparatus useful in re-education are of two kinds, those which are useful in over-

coming defects and those which are useful as compensations for defects. The first may be illustrated by those forms of braces and casts which are used for overcoming conditions of deformity, ankylosis, and the like. The second class includes those kinds of appliances which help weak parts to work against stronger parts. The application of the first class of apparatus should be left entirely to the orthopedic surgeon and should be changed only in accordance with his direction. The usefulness of the second type of apparatus is that it may be experimentally shortened by the instructor from time to time in order to determine to what extent the subject has attained the capability of carrying on his activities without it, or without so much of it.

In much re-education work the use of rigid splints is to be deprecated. Except those which are needed for the support of parts in order to rest them, as in the case of shoulder muscles, or to support the body, as in the case of corsets which will enable the individual to stand, they should not be used. Whenever possible flexible splints should be used and these may be corset steels, spiral springs, or even rubber bands. In the foot-drop in cerebral paralysis or poliomyelitis it is frequent to find that there has been applied a rigid splint to hold the foot at a right angle to the leg. This is done to prevent the pulling action of the gastrocnemius and soleus muscles but it should not be used as a routine. Valuable as it is in certain cases it is more advisable to attach to the toe of the shoe a supporting spring whose tension can be regulated to correspond

with the recovery of the anterior group. This may be accomplished with a heavy rubber band or a small spiral spring. Attachment may be made at the upper end to a garter below the knee and at the other end slightly towards the outer part of the toe of the shoe. This will help to support the anterior group of muscles, but it will not fixate the ankle. Similarly with wrist drop, the fingers may be incased in thimble-like protectors on the ends of corset steels which are led up the arm beyond the wrist to compensate for the weakened extensors. This will prevent the flexors from becoming permanently shortened, and it will prevent over-fatigue of either group.

Whatever apparatus of a semi-permanent type is used should be of a character that an attendant who is relatively unskilled, or the patient himself, can apply. If the apparatus is cumbersome and unsightly the patient will become discouraged and disgusted with it and whenever possible he will leave it off. If it is heavy it will have a tendency to over-fatigue certain muscle groups, and with many patients it will therefore be detrimental rather than of value. These three points (ease of application, convenience and appearance, weight) must be taken into account, and in individual cases difficulties must be overcome by ingenuity, or the patient must be educated to disregard them and to recognize their necessity.

Many exercises, especially those after the subject has recovered a certain amount of ability are to be carried out free in a standing position. This is especially necessary in the so-called free

or gymnastic movements of all kinds. At the beginning of the re-education of a patient, however, it is not possible to carry out all those procedures needed by him when he is sitting or standing. Most of the exercises may then have to be carried out when the subject is lying. If this must be done a hard couch or a table should be used. A bed with springs which vibrates with every movement is less satisfactory than the smooth ungiving surface of a table. If it appears that the exercises may have to be carried out for a long period, or if usable for more than one subject, a special table should be constructed. On this there may be fitted such contrivances as are needed to aid the patient, in the carrying out of his exercises. For many of the movements the table should be provided with suitable handles at the head and at the side by which the subject may hold when resistive exercises are being given. A removable footboard should be arranged so that during many of the arm exercises the patient does not become disturbed by the tendency to slide along the table. If he is not kept in one place the exercises will be poorly done and if the feet and legs project over the end of the table the subject will pay as much attention to his discomfort as to the exercise. A smooth varnished table has an advantage in that its surface will permit the determination of certain activities of very slight amount, which even the weight of the pendant limb will sometimes prevent. In a very much weakened shoulder girdle for example the weight of the pendant arm may be quite sufficient to prevent an actual movement of abduction, whereas

when the subject is lying upon the table the mechanical work to be performed in the movement is much less than when the arm as a whole may be moved. It is advisable also to provide a number of bags of sand which can be placed upon the table, behind or in front of the subject to support him when he is lying upon his side, and when movements in the fronto-dorsal plan of the body are being carried out. A table is almost essential for the proper measurement of the capability of various muscle groups, because the action of the individual muscles should be determined when the movements are free and otherwise unresisted by accessory conditions.

The clothing should be as little as the patient can be got to wear. For men bathing trunks are advised, and for the women two-piece men's jersey bathing suits or a free bloomer costume which does not constrict the waist. In every case the clothing must not interfere with the movements of the legs and of the arms. In those cases in which the abdominal muscles are to be exercised constrictions about the waist during the period of exercise are contra-indicated, and the closely fitting cotton jersey bathing suit is most useful. Through this material the movements can be felt and can be controlled without difficulty. In all cases in which massage is done the part must be bare.

Since we are concerned with the phenomena of behavior in the processes of re-education of all characters, it is important that records be made which enable us to compare the achievement of the individual from time to time. From the pic-

torial side this can best be accomplished by photography. Of the various photographic methods in use, that of moving pictures is by far the best for this purpose. This method of recording performance is, however, expensive, and it can be used only when the subject has sufficient means at his command to count little upon the additional expense. The initial cost of an equipment for the taking of moving pictures of the kinds that are needed is not far from $1500, although this may be somewhat reduced by using cheaper cameras which will make three-quarter size pictures rather than the standard film. This also will reduce the expense of reproduction to a considerable extent, since the smaller films cost less than those of standard size. The film must usually be developed in a commercial establishment and the positives printed there. We may estimate twenty cents as the cost of one finished foot of positive film, which means ten cents for the negative and ten cents for the printing of the positive. The positive film can be projected, studied and compared with past performances. Apparatus may now be purchased which permits the stopping of the film at any point in order that measurements may be made. Any one picture may be compared directly with any other one of the series. It will readily be appreciated that the cost of this work is great, because in a period of an hour there may be used two to four hundred feet of film to illustrate the various activities of the individual. Pictures should be made as frequently as the progress of the patient demands it, and in most cases it is advisable to have these photographs

made about once a month. Since the work must necessarily be carried on indoors, special lighting elements must be used in order that a quick exposure may be properly made. This usually requires a special room in order that the photographs may be taken from a vertical position as well as horizontally. Recently a camera for the taking of 15 feet of exposure has been devised, with the advantage that the operator does not point the camera obviously at the subject. This prevents stage fright. Rapid loading permits the use of as many spools of films as are needed.

For most purposes, however, a much cheaper photographic record may be made by exposing a plate during the time the patient is carrying on an activitity. This will give a picture which shows an indistinctness in the extent of the movement. By the simultaneous photography of a rapidly revolving clock hand the time can be gauged. The picture also will show simultaneous concomitant movements which are used by the patient to support or to bring about those activities which are attempted. In photographic record work of any character it is advantageous to have the patient placed in front of a white screen, marked with ten c.m. divisions both vertically and horizontally, in order that measurements which may be made are comparable and reasonably accurate. It should be needless to say that in whatever photographic work measurements are desired, it is best that the subject should be at a fixed distance from the camera lens in order that photographs on successive days or months may be directly compared by superposition.

In carrying out many of the activities, other graphic records may be made showing the quantity or extent, and the force and time of movement. The values of these records and other ways in which many records are taken are discussed in the next chapter, on the measurement of performance. Records are valuable for purposes of comparison with later attempts, and,

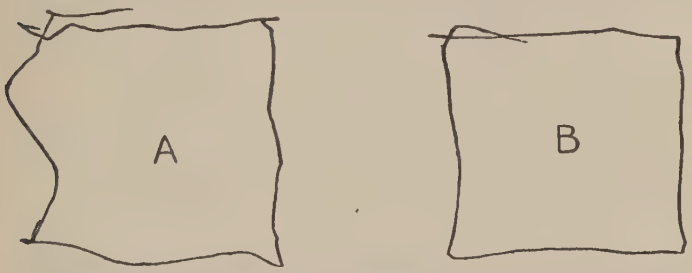

FIGURE 59. Showing the performance of a patient in attempting to trace a two-inch square. The originals were drawn in pencil and the marks were inked over for purposes of reproduction. The illustrations are one-half size of the originals. Figure A is of the date Nov. 26, 1917; Figure B, Dec. 22, 1917. Note in Figure A the accessory lines and the short strokes as compared with those in Figure B.

whenever it is possible to make such records, this should be done. It many cases the records not only give evidence of difference in force, time, or extent of the activity, but they also show differences in quality or in general accuracy. This will readily be appreciated from the comparison of the attempts at tracing with a pencil a two-inch square. Example of a subject's performance at two periods are reproduced herewith. They show the capability of a patient in the first week of training and after a month of re-education.

Many activities of the hand and arm may be measured by the use of large sheets of paper and a soft pencil. Comparison can readily be made of the activities if the paper is partly transparent or translucent so that the records can be superimposed and compared by means of transmitted light. For recording the activity of walking one of the best methods is that of using newsprint paper, about 36 inches in width, which is tacked to the floor by thumb tacks, as many feet in length being laid down as the room will permit. Woolen socks are placed on the subject's feet then dipped in a weak solution of permanganate of potash, and the patient is instructed to walk the length of the paper. If a cane or crutches are used the ends should also be covered with cloth pads which are dipped in the same solution. The transfer of part of the solution from the socks to the paper leaves a permanent record. This record may be filed away for subsequent measurement or for comparison with later records. From such a record one can determine the character and the extent of the step. Not infrequently at the same time one can determine a variation in the force with which each leg is used and the amount of dependence upon cane or crutch. These records can also be utilized to great advantage towards the encouragement of the subject just as other records of performance are used. Moreover faults in his activities may be more readily demonstrated to him and his attention can the more easily be directed to correcting the faults than if he is entirely dependent upon the verbal admonitions of the instructor.

In connection with the exercises the patient should be accustomed to observe his activities in front of a mirror. This is especially important in connection with the re-acquisition of those movements which are required in vocalization (see chapter 11) but the method is equally of value in connection with other motor activities. The use of long and quite broad mirrors is advisable in order that the patient may see all parts of the body in action at one time. In some exercises it is important that the subject shall carry out his activities in a recumbent position. If the mirror is used constantly it will be necessary to have one applied to the ceiling. This, however, is not important. Most of the re-education procedures in which the patient's attention is to be directed to his activities and to their refinement of control will be carried out with the patient in the standing or sitting positions.

The rule of thumb applied in the measurement of the capability of an individual is just as accurate as it is in relation to any scientific work, which means that it has practically no accuracy (see chapter 7). It is dependent upon the casual examination and determination of more or less. It leads to erroneous conclusions and does not result in the proper prescription of those exercises which are of value. The casual examination, which is always a brief and careless one, leads to very little good either for the instructor or for the patient. Every examination which is carried out for the purpose of disclosing the extent of the abnormality should be applied as far as possible to all parts of the body since frequently unex-

pected inefficiencies are found which sometimes are of major importance. This has been well shown in the application of the spring balance test of Lovett and Martin.

At the beginning of a course in re-education for any subject all exercises should be carried out in the presence of an assistant as well as the instructor. There are two reasons for this. The first is that the assistant should know what kinds of activities are prescribed for and carried out by the subject. Secondly, it is important that the subject may get the benefit which is very great in some cases, of the added personal stimulus. In carrying out the re-education work at subsequent periods the assistant will be able to recognize the most suitable points for encouragement and direction. Every action looking towards the re-education of a subject should be carried out at command. Its time should be regular, and its force should be controlled. This cannot be done without knowing what the subject's capabilities are, and these capabilities cannot be accurately described or transmitted from one operator to another in verbal terms or charts. If for any reason the instructor cannot supervise a lesson, his assistant may be able to carry on the training, based upon the knowledge and experience the instructor has gained, and with special instructions. Under the immediate direction of an assistant who follows up certain routine procedures, the patient will improve, but even in these cases it is advantageous for the physician or re-educator to direct his attention occasionally to the individual patient. This produces or furnishes an

extra stimulus during periods of slight improvement and its effect is notable in many cases.

Voluntary coöperation is obtained with difficulty, or it may not be obtained to any appreciable extent, in the case of young children and with some who are relatively feebleminded. Dependence must frequently be placed upon the ingenuity of attendants, mothers, nurses, or tutors who may be constantly with the patient, and who must then be educated for the particular case as re-education assistants. In many instances rewards are valuable adjuncts. These cases are, however, less amenable as a rule to re-education efforts. They require much more of routine muscle training, and results may be obtained only over a long period of time, but improvement results even though the exercises may be less skillfully applied than with the coöperative adolescent or adult.

Some re-education of certain subjects can be carried out by correspondence. This can be done only after the initial exercises, with the more intelligent subjects and in families in which one or more members may be given some special instructions applicable to the subject's condition. In the organic cases this can be well done after the subject has attained control of his neuro-muscular apparatus, and in the psychotic when the reactions have almost reached the normal plane. With the aphasic after the careful examination has been made, much can be done by correspondence with the patient and his family.

Attention has already been directed to the necessity of having the patient adapt himself to

many people in the environment and to meeting numerous conditions. At the beginning of the re-education of an individual it is best to have all exercises carried out by the operator alone with the subject, or in the presence of his assistant. After the subject has been re-educated to an extent that he knows that certain movements can be well executed at all times and at command, and that other movements cannot, it is well to have the subject exhibit his accomplishments to others. Beyond the preliminary exercises it is advantageous to the patient, in so far as his modesty will permit, to meet the conditions which he must get accustomed to in his daily life. In some cases in which re-education is attempted this is of greater importance even in the beginning of re-education. Certain individuals who show spasmodic tendencies (the chronic choreas, paralysis agitans, spasmodic laughing or crying accompanying lesions of the lenticular nucleus, and those who have tonic perseveration) are cases in point. By suitable measures applied to any of these cases the re-educator by himself may bring about a much more normal activity in the subject but when new stimuli, like that of another observer, are received the subject frequently reverts to his original condition. It is therefore essential that self-consciousness or embarrassment, or whatever else the state may be called, should be undermined by training the subject to respond at all times, under a variety of conditions. This applies to the psychotic also, who must become social if they are to be normal.

CHAPTER VII

MEASUREMENT OF PERFORMANCE.

In all scientific work measurement is not only desirable but necessary. Certain of the measures we make are necessarily gross and relatively inaccurate, but in all work the attempt should be made to use as accurate measures as are needed for the determination of the limits of the phenomena with which we deal. When we measure a room for a carpet it is not necessary that we shall measure its length and breadth to the nearest hundredth of an inch. Measurement to the nearest inch or half inch is quite sufficient. If we wish to weigh food for the purpose of sale or purchase it is not necessary that it should be done to the nearest grain. Weight to the nearest ounce, and in a few cases to the nearest half or quarter ounce is sufficiently exact for food, whereas when we weigh drugs it is often necessary that our measure be taken to the nearest tenth of a grain. If we employ an individual it is not important to measure his working time to the nearest second but it is sufficiently accurate to take the time to the nearest minute, sometimes to five minutes or even to ten minues. These usual methods of dealing with certain everyday problems may well be considered by both the investigator and the professional man in the measurement of the phenom-

ena with which they have to deal. Whenever possible a measurement of some sort should be applied to the thing which is under consideration but the limits of the measure required must be kept in mind.

In most cases it is necessary to have a numerical determination or estimation, and in many instances it is only by the report of measurements that it is possible to represent accurately to others what one is concerned with. The physician no longer thinks it sufficiently accurate to determine in a patient the condition of fever or the reverse by feeling him with his hand. He applies to the patient a measuring instrument, the thermometer, in order that reasonably accurate data may be obtained, and in order that the measurements may be utilized at a later date for comparison with subsequent observations on the same patient or with other observations on other patients. Nor does the physician consider it sufficient to feel the pulse to determine the systolic or disastolic pressure in the arteries. He applies measuring instruments which within certain limitations of error can be used for the accumulation of more accurate data which are useful in diagnosis, and which can also be utilized for comparison with other similarly obtained data from the same patient at other times or from groups of patients.

In re-education advisement and procedures a difficulty which has been encountered is that of a reasonable measurement of performance of the patient which will give an idea of his capability. Inspection and the application of poorly defined

criteria are not sufficient. It is important to know what the defective individual can accomplish. It is equally important to know how his accomplishment varies from time to time under the influence of the re-education procedures which are being carried out, just as it is important for the physician to know how the temperature of the typhoid fever patient varies in the course of the disease and in accordance with the treatment which is instituted. It will be shown later that the measurement of performance is also of importance in the direction that may be called the therapeutic or re-education approach. In the latter way it points out what should be done. It is also known that measurements of a patient's performances are of value towards his encouragement and as a stimulation if the results are properly explained to him. This can be done by the use either of numerical values or of charts which can be simply constructed.

It should be equally unnecessary to say that it is important to determine the capability of a patient who appears to be in need of re-education as it is to say that the individual who is ill needs a careful examination. The patient needing re-education cannot be intelligently dealt with until those careful tests and measurements are made which will adequately represent the condition of the patient at the moment of examination. The terms weak and strong, large and small, fast and slow, have some designating values, but these qualitative terms lack that accuracy which is essential if we are to "know" rather than "guess," and if we are to advise the patient intelligently

rather than feed him mental bread pills. If it is desirable and important these qualitative terms can be put into more scientific ones of strength, length, and time. In most cases it is both desirable and important. How some measures may be made is explained in the previous chapter on movement.

It has been said above that the measures are of value as an indication of therapeutic or re-education approach. By this is meant that the amounts of defects which are present are determined by making necessary measurements rather than by depending solely upon the feelings or reports of the patient. At the same time the measurements show the degrees of the defects against which our re-education activities are to be directed. In a subsequent paragraph it will be shown how the measurements and the plotting of the data are indicative of the emphasis that should be given to certain procedures. The measures taken from week to week, or from month to month, indicate the amount of progress or the lack of progress in different directions. They show those elements or functions in the individual which need relatively little and those which need relatively great amounts of re-education attention.

We may best illustrate the value and some of the methods of measurement by taking concrete examples. Although the examples refer to the extent of movement, the general statement is equally applicable to the other characteristics with which we must concern ourselves. The patients undergoing re-education were paralyzed be-

cause of cerebral lesions. Each day measurements were made of the capabilities in accordance with the various characteristics that were thought to be worth observing. These measures of extent of movement were made over a period of twelve weeks, for two of the arm segments and for one kind of movement in each segment. On each day five measurements of each of these movements were made, and these data are shown

TABLE II.

Comparison of average weekly performance in flexion movements of wrist and medius finger. Patient, Mrs. C., was a cerebral hemiplegic, of 7 yrs. duration. Figures are circular degrees. Systematic exercises were omitted from the 13th to 20th wks.

Serial Weeks	1	2	3	4	5	6	7	8	9	10	11	12	32
Wrist	24	21	17	14	56	58	46	52	62	63	69	60	60
Medius Finger	16	0	28	21	47	58	90	90	90	90	90	90	85

in the accompanying Table II, averaged for weekly periods. Examination of the table and comparison of results in relation to the normal quantity of movement reveal the fact that in a period of seven weeks there was a recovery of the maximum normal amount of movement of finger flexion, whereas the normal amount of movement of wrist flexion was not obtained. This fact indicates that after the first seven weeks the therapeutic attack should have been directed primarily to the wrist rather than to the finger movement. The individual measurements of another patient for part of the re-education period are given in Table III. This table shows that the individual and the average daily measures are not significant and that the variations from day to day are relatively large. The weekly averages show more

of a gradual improvement than do the large up-and-down fluctuations which are found in the day-to-day measures, and in those individual serial measures which were taken on one day. In later work, because the daily measurements did not indicate facts of value, weekly measurements

TABLE III.

Giving the individual measurements of thumb adduction in a paralyzed patient, Mrs. M., in the course of re-education, with a comparison of the daily and 6-day averages. All figures are those of circular degrees.

Dates	Individual Measurements					Daily Averages	6-day Aver.
June 30	25	30	30	30	35	30	
July 1	20	20	20	20	20	20	
2	20	25	20	25	25	23	28.3
4	25	30	30	30	35	30	
6	30	30	30	35	33	32	
7	35	35	35	35	35	35	
8	40	40	45	40	40	41	
9	30	35	35	35	35	34	
10	35	35	35	40	45	38	39.3
12	35	40	40	40	35	38	
13	40	40	40	40	40	40	
14	45	45	45	45	45	45	
15	45	45	45	45	45	45	
16	15	25	20	25	20	21	
17	25	20	30	30	30	27	35.7
18	30	30	15	25	25	26	
19	45	45	45	45	45	45	
20	50	50	50	50	50	50	

were substituted. The weekly measures show the same characteristics of improvement which were found by averaging all of the daily observations.

We must also consider the number of measurements which are necessary to determine the character and the amount of a defect, the progress of the individual, or the value of the re-education attack. If it was possible to have an absolute measure of performance for all of the characters which

we desire to measure, a single measure at any one time would suffice, just as one thermometric measure is usually sufficient to determine the presence or absence of fever. In the chapter on movement mention is made of the difficulties in making measurements such as we desire. If, for example, we desire to determine the extent of a certain movement we apply what appliances we have which will serve the purpose. The patient executes the movement, we record the observations. From a critical view of the situation, however, we realize that the measurements we make are necessarily relative. Their accuracy depends upon two factors, or speaking more precisely we say that there are two well recognized sources of error. One of these is the error of observation of the instructor who makes and records the measurement. His estimation may be relatively rough or fine, in accordance with his experience or his vision or other personal elements, and in accordance with the accuracy of the instrument and its adjustment. The second error, which is not an error in the usual sense of the word, is the variability in the activity of the patient, who at one time may be able to do a little more or a little less than at another time.

The first of these errors has a tendency to be constant, the observer having a proneness to overestimate or to underestimate the amount of the performance or to apply his apparatus in one special way, and the instrument being equally adjusted for all measurements. Measurements by one observer may be constantly less or greater than those of another, even though both observers

are equally skilled and as frequently occupied in making the necessary measurements. This personal equation can be determined and compensated for, but it is usually not necessary. The second error, that relating to the actual performance of the patient, is a more variable error be-

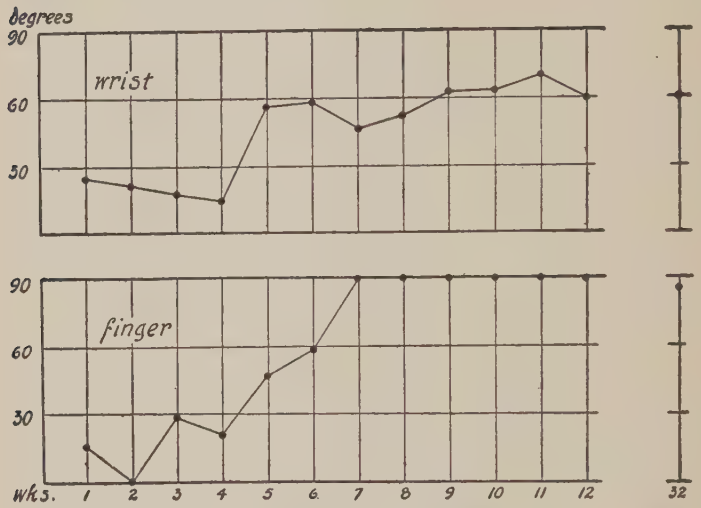

FIGURE 60. Two curves showing improvement in the movements of flexion of the wrist and of the finger, in a hemiplegic patient under re-education. The weekly averages of performance were used in the construction of the curves.

cause the condition of the patient, such as fatigue or interest or other mental state, will differ considerably from minute to minute as well as from day to day. It is well recognized, however, that if several measurements are made, and if these data are averaged, there is generally a tendency to overcome or to counterbalance the variable errors in the average. The constant errors are not

counterbalanced, because they are the same in all determinations. If, however, one instructor makes the measurements on the same patient or on groups of patients from time to time, his constant errors are of relatively little importance, because it is the relative performances of the patient from day to day or from week to week, to which we attend.

How the measurements which have already been described are to be charted is shown in the accompanying illustration. Two curves are shown relating respectively to flexion at the elbow and at the wrist, Figure 60. In the vertical direction are shown the amounts of movement, actually the average amounts. The serial weeks of re-education are indicated along the horizontal line. The amount of the vertical distance from the main horizontal line at any weekly interval shows the amount of performance for that particular week. On the diagram the points indicating the performances at weekly intervals are shown with large dots. These dots are connected by light lines which make a curve. The inclination of the curve indicates clearly whether or not improvement has taken place. The upper horizontal line on each of the two diagrams represents the usual maximum of movement in the normal individual. From the lower horizontal line to the upper horizontal line is the distance which represents the quantity of normal movement. If the tested individual is normal the curve of performance would be a straight line superimposed upon the upper horizontal line. In the examples given the ability of the patient at the beginning of the re-education is

shown to be much reduced. When, however, the curved line approaches the upper horizontal line, we say that the patient approaches the normal. In comparing the two parts of the figure it will be seen that the curve representing the flexions of the finger has reached the upper horizontal line at the seventh week, whereas at no time in the period for which the charting is shown has the performance at the wrist approached the upper horizontal line. These differences are important to note in relation to the conduct of the re-education program. They show that at the end of the seventh week little or no further attention need be paid to the movements at the finger but that special attention should be directed to the activities of the wrist. Training on wrist movements should, therefore, be continued until the line showing accomplishment, or improvement for those movements, has approached or reached the normal line. The diagrams show that in all probability during the first weeks much more attention should have been paid to those exercises which would bring about improvement in the wrist segment.

As has already been noted, plotting of curves in this way is of value to the patient for the creation of an attitude, for his encouragement and for the securing of his active coöperation. For example, the curves can be shown to the patient and explained to him. His attention may be directed to the lack of improvement in one particular, so that he may increase his efforts in that direction. The course of improvement in any movement can also be shown to him as an encouragement and as an indication of the possibility of a further im-

provement in that segment, and as an example of what is to be expected in another segment which has not attained the normal amount of its activity. At the same time the charts of improvement show progress graphically to the patient, and they replace the instructor's general statements which are not infrequently doubted especially when the

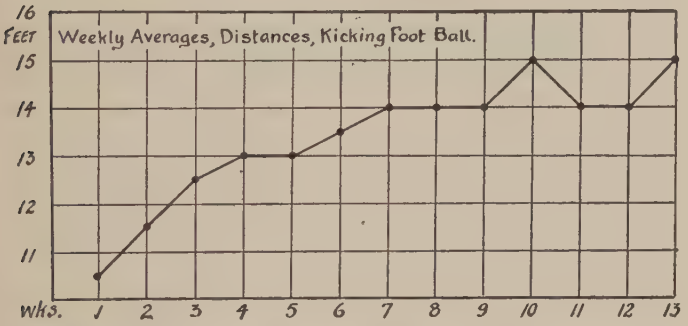

FIGURE 61. Curve showing improvement of a cerebral hemplegic, in kicking a foot ball over a lawn. Weekly averages are shown. Note the plateau reached at the 7th week; and the subsequent irregular improvement.

improvement is slow or slight in amount. It is possible to compare the patient's improvement with that of another patient. An incentive to equal or to surpass the other may also be created, and this competition is of special value.

To this point attention has been directed only to the simpler types of movements, curves for which are readily constructed when the method of obtaining the measurements is relatively simple. It should be borne in mind however that practically every activity can be represented in the form of a curve which will show improvement or lack of

improvement. In many instances of complex activities it may be difficult to represent the quantities of performance of an activity as a whole, but it is always possible to represent it in part. A curve of progress can be constructed which will represent the course of improvement to the patient, however little scientific value it may have. There is here reproduced a curve, Figure 61, for a complex type of activity, that in which the individual kicked a round football over a lawn. This curve represents the average distances the ball was kicked, week by week. Even from a relatively superficial analysis of this exercise it will readily be seen that there are many variable factors in the conditions which accompany the experimental procedure, and that the kicking is in itself complex and made up of many elements. The more important conditions that are variable are the placement of the ball, the amount and tension of the air within it, the hardness and wetness of the ground, and the length of the blades of grass. A variation in any one of these conditions will affect the distance to which the ball may be kicked even though the force of the kick remains constant. The main factors in the complex of the activity are the accuracy of direction of movement and the force of the kick. Other elements such as the poise of the body and the control of concomitant movements are important in relation to the two last mentioned. Even though the conditions are complex, it is possible in this case to represent the results in a manner which is obvious to the patient. They can, therefore, be used as an encouragement to him. Fre-

quently curves such as these show wide variations from week to week on account of the numerous variables which are encountered, both external and internal to the individual.

Because of the values to the instructor and to patient it is advantageous to construct curves of improvement for all exercises or to represent the performances in graphic terms as far as possible. For some complex activities this can be accomplished only in part, because the activity varies in difficulty from time to time. Thus, in the weaving of a table scarf which was set on a loom a patient under re-education wove in successive one-hour periods per day the following numbers of cross threads: 9, 11, 15, 8, 21, 16, 12, 18, 14, 12, 15, 15, 17, 19, 22, 14, 17, 18, 15, 19, 21, 17, 22, 26, 18, 20, 21, 19, 25, 21, 19, 22, 26, 23, 19, 24, 23, 18, 24, 16, 18, 14. These daily performances were not always on regularly successive days, but at times there were intervals as long as three days. A total of 42 hours were needed to finish the job. Part of the time was consumed in winding up the work already done, and on some days, therefore, the amounts of weaving were not greater. The course of the work can, however, be well represented by taking the totals or the averages for

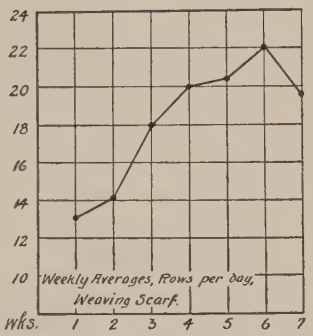

FIGURE 62. Showing how a complex activity may be charted to show improvement. The average daily numbers of rows woven in a scarf is charted.

six-day periods. When this is done the curve of improvement is that shown in Figure 62. It should be noted that this curve does not show a regular increase in quantity, but if it be desired to encourage the patient an allowance for smaller performances on certain dates can be made and added to the actual accomplishment. This may be of special importance at the ending of the job, when the "finishing" takes more time. If three-day periods are taken for comparison there are greater variations. For other complex activities measurements may be poor but it is always possible to make estimations and to compare longer serial periods. In some cases accuracy instead of speed should be the data sought. Even in such matters as sewing, or in embroidery, where accuracy is difficult to measure, values estimated in numerical terms can be used for the purpose of comparison. In all cases in which estimations are made, even by those who are not concerned in the re-education process, the data will show improvements, especially if the daily fluctuations are practically disregarded by combining the measurements for longer periods.

PART III

NEUROLOGICAL AND MENTAL ADJUSTMENTS

CHAPTER VIII

POLIOMYELITIS, OR INFANTILE PARALYSIS.

Anterior poliomyelitis, or infantile paralysis as it is commonly called, has a number of clinical forms. These are not entirely distinct and they are frequently combined so that the defects of different patients may vary considerably, so much so that the symptoms of two patients may lead an observer to believe that there are two or more diseases. Lovett has given an excellent account of the various forms, both simple and combined. The most simple of the various classifications is that by Peabody, Draper and Cochez. They have grouped the cases into three classes. The abortive form is one in which the infection has produced no marked symptoms beyond that of the initial fever and its accompanying delirium etc., and in which the paralyses, if they exist, are so slight that they escape all but the most careful examination. The cerebral cases, in which some nerve elements in the brain are involved and in which the toxic or infective agent acts upon those neurones to bring about a condition of cerebral paralysis like other cerebral paralyses, in children or in adults, due to hemorrhage or to other accidents. The third group is the spinal group in which the lower motor nerve elements are involved, the paralyses being due to destruction of

cells in the mid-brain or the medulla oblongata, and especially in the spinal cord. It is this last type which is most common. It is considered to be typical of poliomyelitis, and it will chiefly concern us here. Although in poliomyelitis of the usual, or flaccid, forms the main manifestations are those of paralysis, it is not unusual to find that the patient also complains of pains and tenderness over considerable areas. These symptoms are pathologically to be associated with interferences with parts of the afferent or sensory fibers or cells in the spinal cord. It would be almost unthinkable to believe that, with the extensive destructions which sometimes take place in the gray matter of the spinal cord, some of the afferent conducting fibers and some of the intercalated cells should not also be seriously affected or destroyed. Although in many cases there are sensory disturbances we are more concerned with paralytic conditions that follow the destructive lesions in poliomyelitis. We are also chiefly concerned with the re-education procedures that must be directed to the overcoming of, or to the compensation for, the paralyses.

Although the resulting paralyses are usually limited to one or two bodily segments, the paralysis in many cases is widespread. Those motor neurons may be involved which control practically all the muscles in both arms; or in both legs; or those of an arm, a leg, the abdomen, and chest, on one side, or the paralysis may be spread over the trunk and both arms and both legs, involving in these areas widely separated or contiguous muscle groups in both halves of the

body. Careful examination of these cases by means of the muscle balance test of Lovett and Martin reveals that in a very considerable percentage of cases the paralysis of one muscle or group of muscles is not usually complete. Frequently parts of muscles have escaped the effects of the widespread destruction of the anterior horn cells in the spinal cord. Apparently not all the spinal cells for the control of certain muscles or muscle groups are destroyed. Not infrequently also careful examinations by available tests show that, although certain muscles do not obviously exhibit a paralysis, these muscles frequently exhibit a weakness compared with corresponding normal muscles. With regard to this point Lovett has cited the results of the careful examinations of 10 cases which by ordinary manual examination showed that only one leg was affected. By careful testing with the muscle balance, nine of the individuals also showed weakness of certain muscles in the muscle groups of the other leg. This result must be understood to mean that although there was not an extensive destruction of the anterior horn cells controlling the muscles of the contralateral leg, some of the spinal elements were destroyed by the toxin. There was thus produced a partial involvement of other muscles which was evidenced by the weakening. This finding is a good example of the necessity for careful examination of parts that do not superficially appear to be paralyzed and it also shows that the determination of even minor defects in all abnormal cases may be of value.

The accessory conditions that accompany the

paralysis in poliomyelitis, as also in the spastic paralyses of childhood and those due to cerebral syphilis and arteriosclerosis, are of importance. Because of the presence of a paralysis not infrequently we find that an arm or a leg which can be used readily is used to a much greater extent than is normal or good for it. This may result in overcompensation and hypertrophy of the muscles that are used. Or if in this case the use begins during or shortly after the acute illness, the continued use of these muscles may overtire them. The overtiring tends to bring about in the muscles which are extensively used, or in the corresponding nerve elements controlling these muscles, a condition which is practically the same as that of paralysis. In other cases in which the paralysis is obvious and apparently complete for one segment, the arm or leg may be held continuously in one position. If this tendency is not properly dealt with and overcome, the retention of the part in one position is apt to lead to permanent bony changes. This is especially true in those individuals in whom the poliomyelitis attack has occurred during childhood or during those years in which growth is important. Similar permanent deformities may be produced by the overactivity of nonparalyzed or by slightly paralyzed muscles. Thus, if the flexors of the arm are paralyzed, the extensors tend to pull the arm into an extensor position and to hold it there. This is similar to those deformities in the spastic paralyses of cerebral type in which, however, we usually find that the greater strengths of the flexor groups overcome the extensors and thereby produce contrac-

tures. In the poliomyelitis cases, although the ultimate cause is different from the cerebral cases, we find a condition which corresponds, in that those muscles which are active or partially active can easily overcome those muscles which are considerably paralyzed or which have relatively little strength. This explains the deformities such as equinus, or club foot, which is not infrequent when there is involvement of the leg muscles.

Following the acute illness there is evident a paralysis. The amount of the paralysis does not remain constant, and just as in the cases of cerebral paralysis, a so-called spontaneous or normal improvement may appear. Frequently the spontaneous improvement is supposed to be produced within the period of six months after the febrile disturbance has subsided, but it is now recognized that even after a year some voluntary improvement may take place. An interesting account of this by Lovett indicates that in "one case of four years' duration seventy per cent. of improvement occurred in two months in muscles not being trained and four hundred and seventy per cent. in the muscles treated with muscle training." This shows that even after four years, some so-called voluntary or spontaneous improvement may take place, but as compared with the improvement in muscles which are being actively worked with by re-education procedures the amount of improvement is much less. The same author has also cited comparative results in seven other cases in which he found that in measurements taken at the beginning and at the end of a year, during which the patients had received no treatment,

there was evidence of a spontaneous gain in power in nineteen groups of muscles out of thirty-seven muscle groups that were tested.

The surgical interventions that are needed in certain cases do not concern us here. With this exception, the treatment of the paralysis of this type may be briefly characterized under two heads, rest and exercise. The patient recognizing his deficiency and being anxious to overcome it, has the tendency always to take too much exercise. Either he wishes to see what he can do or he tries to keep up to normal what muscular control he retains. As has already been indicated, in those muscle groups in which relatively few muscle fibers are being stimulated through the spinal nerve cells, over-exercise may bring about the state which is the opposite of that desired. It may cause a permanent damage to the nerve cells and to the muscles which are over exercised. When carried to the extreme the over exercise will result in additional paralysis rather than in a betterment or an increase in activity. In many cases in which the muscles and the nervous elements are considerably weakened, rest is of greater value to the patient than exercise. Especially during the early months following an attack of poliomyelitis, few and well regulated exercises followed by long periods of rest must be the main line of re-education. The emphasis should be placed upon the rest periods. In all cases care must be taken not to fatigue, or to unduly fatigue, the neuromuscular apparatus. As in other re-education procedures haste is detrimental.

Immediately following the onset of the par-

alysis, rest is of much more importance than any kind of treatment. At this time, both on the part of the patient and his physician there is frequently a tendency to attempt active treatment for the paralyzed segments, to try to get the patient to move whatever can be moved. Massage in its different forms is also often utilized to stimulate the muscles and not infrequently electrical treatments are given. None of these should be attempted for a considerable time after the acute febrile disturbances have subsided. The patient needs to be instructed in the value of rest, and he should be encouraged to rest the affected muscles as much as possible. This is primarily for the purpose of allowing for the "normal" recovery from the acute infective and toxic disturbances as much as possible. At this time outside interference with the patient's normal or spontaneous recovery should not be permitted. As a rule exercise should be begun only after several weeks.

When paralyses have been carefully noted by means of the muscle balance tests, it is advantageous to support by braces, splints, and other appliances parts of the body which need support. Where opposing muscles are not completely paralyzed, for example in the arm or leg, the patient may be materially helped by the use of a brace or splint. This support should be used in such a position that the nonparalyzed muscle does not become permanently shortened as it usually does in the non-treated cerebral paralyses. An example of this will make matters plain. Let us consider a case in which there is a partial paralysis of the shoulder muscles concerned in abduction. If

there is a retention of normal or almost normal power in the adductors, if the paralyzed abductors are not thoroughly rested and supported by a brace, there will result a shortening of the adductors. This will then produce a permanent adduction contracture. If, however, the relatively abnormal pull of the adductors against the weakened abductors is prevented or compensated for by a suitable contrivance, the abductors will not be continually pulled upon and stretched, and they will not, therefore, be continually fatigued. Such a piece of apparatus has a two fold purpose. It prevents overstimulation and consequent weakening of already weakened or paralyzed muscles, and, even if these muscles are eventually found to be totally paralyzed the use of a support or a splint prevents the deformity of a contracture and ankylosis. Whatever activity of the abductors remains, after the destruction of some of the spinal cord cells controlling them, should be preserved until the time comes for active intervention by exercise. The rest induced by constant support will accomplish this.

In addition to the apparatus for the rest of individual muscles and to prevent the formation of contracture and ankyloses, special apparatus may be needed at later periods for the support of various parts of the body which are not supported through their own muscle activity. It is not infrequent to find in those patients in whom there is an obvious involvement of the arms or an involvement of the legs a concomitant, but not an obvious, paralysis of the abdominal muscles. A wise procedure to follow in practically all cases in which

there appears to be any degree of over-weakness of these muscles is to use an abdominal support of the nature of a corset which will prevent the stretching of the abdominal muscles when the individual is sitting or standing. If the abdominal weakness is uncorrected in some way it may lead to subsequent symptoms of gastro-intestinal disturbance, such as enteroptosis and the like. Such a support should be comfortably tight and should be placed in position upon the patient when the patient is lying down, and when, therefore, the muscles are not stretched by the weight of the abdominal viscera. In this connection it is almost needless to say that this corset or binder must be fitted to the individual patient, and it is better to have one especially constructed for him. In order that the support may have its best effect it is also important that the binder should cover the hips and it should be held in place by straps which come over the shoulders.

Braces and similar apparatus for the support of other parts of the body may also be needed. The true functions of these should be understood by the re-educator, and, if possible, their values and uses should also be explained to the patient. They are accessories—they are to prevent deformities, to help weak muscles, to overcome the greater pull of strong muscles over weaker muscles of a group. In themselves they have no therapeutic value beyond this. At no time, except in those few cases in which there is total or absolute paralysis of a group, should they be considered to be primary and to be utilized by themselves as means of overcoming any of the paralyses. Ac-

tually they are only aids to rest certain muscles or muscle groups and to prevent contracture. They do not overcome the paralysis, they cannot help the weakened muscles beyond protecting them from too great strain. Their use should be discontinued just as soon as the patient is able to make his own muscular compensations. They should be changed from time to time in accordance with the increasing capabilities of the subject, and so far as possible they should be discarded when re-education has sufficiently progressed.

Exercises given to poliomyelitis patients may be of the two kinds, already described, passive and active. The passive exercises should be carried out mainly by the various procedures grouped under the term massage, and by the stimulation of the muscles and the nerves by electricity. The active exercises which are undertaken are to be grouped into two classes. The first of these is that group of exercises which are like the activities of normal individuals in the execution of movements as movements. This kind of active exercise may be said to be the attempt to get the individual to carry out motor activities of definite purposes. The second kind of active exercises is that which has been called muscle training. Here the effort is made to get the patient to concentrate upon the contraction and the relaxation of individual muscles or muscle groups independent of their so-called combined values or uses. In the hands of certain re-education experts muscle training has been found to be very valuable in enabling the patient to recognize his absolute control. It is especially useful when intelligent patients are

being dealt with whose coöperation can be easily obtained. It has little value in younger children.

The exercises which are advisable in any one case can be determined only after a complete examination which has shown the paralyses or weakness of individual muscles and muscle groups. When the results of the examination have been tabulated and the relative strengths of muscles compared with those of normal individuals in accordance with the table which is to be found in the chapter on movement (see page 68), the appropriate exercises should be planned. Although it may be logically incorrect in making plans for either children or adults, I have been accustomed to keep in mind exercises that will correspond to activities which are most needed by the patient in his daily life. This has a two-fold reason; first, to make the individual use some of his paralyzed muscles and prevent a too exclusive compensation in the non-paralyzed groups; and secondly, to encourage the patient by bringing about improvements that are obvious and socially useful to him. It is important, therefore, to select those exercises that will tend to improve the ability of the patient to the end that he is able to use his hand and arm in those processes which are needed by him for his daily care, for dressing, for eating, for holding, etc., and to use his leg in a satisfactory fashion for walking. While this plan is not always to be followed accurately, if it can be carried out it is of the greatest value in impressing the patient with the importance of the instruction, and it has also a beneficial effect upon the patient's morale. Giving the patient as it does

confidence in the instructor, it provides him with the stimulus to follow those other exercises which may appear to him to be less necessary, but which the instructor advises. It may well be realized by the instructor that the other exercises are not less important to the patient so far as his general activity and welfare are concerned, but the importance of the patient's confidence and coöperation must not be minimized. At times the direction of re-education procedures into the more immediately useful channels cannot be made because the paralyses involve practically all of the muscles of a large segment. Such an extensive paralysis may make it impossible to direct the initial exercises to that part, however important the movements of that member may be in the daily life of the patient.

At first, in the carrying out of the exercises, it is well for the instructor to demonstrate on the patient the activity desired in a certain segment by the passive corresponding movement of that segment, e.g., flexion, or extension, or rotation. The instructor should then urge the patient to make a corresponding voluntary movement. This method should be carried out with those muscle groups which are apparently completely paralyzed as well as with those in which some muscular force is known to be present. In some cases in which the paralysis of a muscle or a muscle group is not complete, in which some capability of movement is present, it is not infrequent to find that the patient can accomplish only a small part of this movement, let us say a quarter or a third of the whole. When this is found to be the case the

instructor should not permit the patient to cease his efforts at the point of the patient's maximum, but the instructor should carry the movement to its fullest extent, all the time urging the patient to assist in the completion of the movement. In carrying out these exercises, it should be kept in mind, the patient can be materially assisted by placing him in those positions in which his muscles are not compelled to work against gravity. It may be necessary to use a sling or cradle supported from a pulley at the ceiling to accomplish this for the thigh movements, but for the movements at the knee, ankle, shoulder, elbow, and neck the support can be accomplished through the manual support of the instructor.

When it is found that a certain movement can be made, freely or assisted, the training of the muscles and their exercise against graduated resistance is the next step. The instructor is the regulator of the resistance, which in all cases should be of that quantity that the patient can just make the movement. The resistance should be great enough so that the movement is as difficult for the subject as it can be made. In the resistive exercises also it will not infrequently be found that the different parts of a movement are of different degrees of difficulty for the patient. It is, therefore, necessary that the regulation of resistance should at all times correspond with the force exerted by the subject. Until the patient can move with normal, or almost normal, facility the use of resistive appliances, such as gymnastic apparatus and special spring instruments, is not to be recommended. These instruments have

either a constant or an increasing resistance to overcome, while in the execution of a movement the paralytic may have, and frequently has, much greater force at the beginning of the movement that at the end. If the apparatus resistance is regulated for the beginning of the movement, it will be too great for the latter part, and if it is regulated for the weaker part of the movement it will have little value for the stronger part.

The assisted, the free, and the resisted movements should also be carried out at different speeds and tempo. At first slowness and steadiness should be practised, and only later should special attention be directed to producing speed. Having regard for the warning about fatigue and for the necessity of rest periods, exercises on rapidly repeated movements should be given. These may be dispensed with until the subject is able to carry out the special movement with certainty, and in only few cases should they be begun until there has been much improvement in the force and the extent of the movement.

The exercises which are prescribed for the individual muscles or for muscle groups should always be carried out under direction. Especially at the beginning of re-education no exercises should be permitted except those under the immediate supervision and control of the instructor. After the patient has recovered to a certain extent it is to his advantage as well as a saving of time to the instructor to encourage the patient to carry on some of his exercises independently. The point at which the beginning of independent activity appears advisable is when the first plateau in

the curve of improvement has continued for about two weeks. This is shown at A in the accompanying diagram, Figure 63, which is a curve of habit formation as well as that of functional improvement. It has already been explained that at the time the level of improvement has been reached, either extra stimuli are needed to carry the improvement farther or that the improvement has progressed almost to the extent that can be expected. It is also believed that at this time, and while the curve remains at the level, some kind of organization of the activity is taking place.

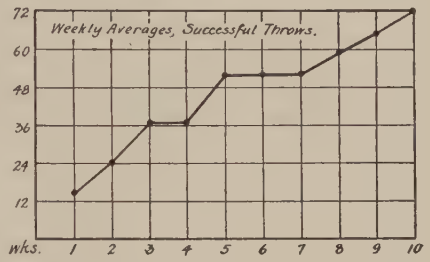

FIGURE 63. Curve showing improvement and plateaus in learning a complex act. The subject picked up from a revolving disk small shot with a pair of tongs and threw them into a four-inch pocket, 24 inches to the right. The curve shows the average weekly successful throws. Note the plateaus at the 3d and 4th weeks, and the 5th and 6th and 7th weeks. (From data in Batson: Acquisition of skill, Psychological Monographs, No. 91, p. 72.) In re-education subjects the plateaus indicate the points at which it is advisable to change the exercises.

Another reason for shifting the direction of re-education at this time is to prevent a narrowness in the patient's activities. With certain individuals there is always the danger that they will acquire a dependence upon the instructor, and, if it is exaggerated by too exclusive a regime, it will tend to retard that recovery which is the aim of the re-education, viz., the return to normal so-

cial activities. The patient should be encouraged to try out by himself various kinds of actions, in order that he may not be restricted in his activities by dependence upon the instructor. The actions, exercises, or work that should be attempted at this time should be prescribed, both in character and time, but as he progresses it is advisable to give him greater latitude in self-selection. At this time also "class-work" becomes of great value both on account of its "social" effect, and because of its stimulating effect in another direction. If the group activities can be suitably arranged so that competition enters, the rivalry will be that stimulus which will tend to "break through" previously unopened channels of action.

In cases which I have dealt with it has been found that two exercise periods a day are much better than one. This is usually possible only for those patients who are in hospitals or institutions, and less frequently is it feasible in private work. In all cases, however, exercises should be carried out at least once a day, the amount of time devoted to each case depending upon the amount of paralysis of the individual muscles and the distribution of the paralyses. It is usually best to limit the exercises which are given to a particular patient to about 15 to 20 minutes each day at the beginning, and gradually to extend this period of time so that the patient is given approximately two hours a day. The longer periods should be broken up by one or more rest intervals, a rest interval following twenty, thirty, or forty minute exercise periods, depending upon the ability of

the patient to withstand the fatigue of the exercises.

If the number of paralyzed groups of muscles is large it may not be possible in the available period of time to go over each group each day. In such an event there becomes evident the value of frequent measurement as an indication of the re-educational needs of the patient. Since, by measurement and the continuous plotting of results, it is possible to determine those parts which are progressing slowly or favorably, it will soon be discovered which parts are in most need of exercises and which are least involved. When a selection of parts is required, those parts should be worked with each day which are in most need of this, and less time need be devoted to those segments or groups in which the improvement is continuous, or in which there has been a return to almost normal level.

The use of electricity in poliomyelitis is extensive. It, however, is not of as great value as the manual exercises because it is not as readily controlled and because it does not give as good results as the resistive movements which have been described. In small doses it probably does no harm, but it does little good. Its greatest beneficial effect is that it encourages the patient to believe that muscular activity is possible even in muscles that he is not able to move voluntarily. In that way he may be urged and encouraged to try various movements which he has been unable to perform, and which because of this he thinks are not possible for him. The only organic value of electricity is that it gives a certain amount of

passive exercise to the muscles to which it is applied, but in this respect it is of less value than the passive exercise of the nature of massage and the active exercises against manual resistance.

CHAPTER IX

LOCOMOTOR ATAXIA.

Although in locomotor ataxia there are numerous symptoms, there are only three important conditions which demand attention from the re-educational standpoint. One of these is purely mental, and the other two are quite unlike other re-educational conditions in organic nervous diseases. The first is the patient's fear or dread of injury, the organic conditions are the lack of control of the bladder and the incoördination in movement.

It has recently been emphasized that a large part of the difficulty of the tabetic is due to his mental state. From experience he has learned that he is not capable of carrying out certain activities well, some of which are of importance in connection with walking and with other necessary accommodations in his daily life. Because of this recognition of inability he frequently gets into a state of chronic dread that he may fall or become incapable of carrying out many actions of which he is capable when these are demanded. The first part of the re-education of a tabetic must necessarily be a re-education or reconstruction of his mental attitude towards his condition. He must be freed from the fear which is obsessing him. The fear must be replaced by confidence in

his own ability to carry out those actions which he was capable of doing prior to the beginning of his difficulties. To bring about this attitude is not always an easy matter since not infrequently the experiences which have led him to consult the neurologist or the re-education expert have been of those characters which emphasize or produce a constant dread of impending harm, that he will be run over, or that he will fall and injure himself through his incapacity. The fact, however, that he consults someone regarding his deficiencies, that he presents himself for the purpose of having the incapacities corrected is the first and, doubtless, the most important step in the direction of recovery. It indicates that he recognizes that the attitude of hopelessness or of fear may be replaced by an attitude of hope and of confidence.

Until well on in the progress of re-education at no time should the instructor ask such a patient to carry out any kind of difficult action which may cause him to lose his balance and thus emphasize the fear. Whenever the patient is standing it is important that he should have the means of self-support immediately at hand if his actions result in considerable swaying and a tendency to fall. In these cases many of the exercises are to be performed first when the patient is standing close to a wall and with a chair on either side. The chair backs should be placed so that he may grasp them for support if occasion arises, or so that he may hold them as a constant support when his regular leg exercises are being carried out. The provision of means for protection furnishes the patient knowledge that it is not possible to injure him-

self. This physical support and the continued suggestion and persuasion of the instructor will soon overcome the fear, and will also give to the patient a better attitude regarding his own capability and his future attainments.

The other two conditions which are found in the tabetic which require re-education are his lack of ability to control the bladder and his ataxia or incoördination. The paralysis of the sphincter and the attendant impossibility of physiologically acting upon the smooth muscles in any certain manner leave little to be done. The most that can be accomplished is to set for the patient those exercises for his abdominal muscles that will enable him to partly compensate for the inactivity of the smooth muscles of the bladder. He must be instructed to void urine at stated intervals after drinking and to regulate the number of voidings in accordance with the amount of liquid which has been taken. When the abdominal muscles can be suitably controlled so that they compensate in part for the inaction of the bladder muscles, much of the discomfort of the patient disappears. His mental state is also improved thereby, because the use of appliances for the collection of urine can largely be dispensed with. His physical comfort and his confidence are increased.

The ataxia or incoördination must be dealt with in the same manner as other motor defects. In conjunction with the ataxia, the patient not infrequently exhibits considerable muscular weakness. He is seen usually only after the early stages of the disease have passed, when he has attempted to compensate for his loss of coördination

by limiting his activity to a great extent. Because of the inactivity the muscles have then lost their tone, and this must be regained if the quickest and greatest benefit is to be obtained by the patient.

Many interesting facts regarding tabetics have been recorded which indicate the value of certain lines of procedure in re-education. In many instances the attack must be individualized in order that it may have the benefit which is desired. In recent years Maloney, who had under observation a number of tabetics who were blind, found that the tabetics of this type did not exhibit the marked incoördinations or inaccuracies which were found in most patients who could see. This observation suggests a change in re-education method from that recommended by Frenkel. Maloney's plan of procedure in the re-education of a patient was based upon the assumption that most of the body activities or collocations of movement are normally carried out in connection with the eyes. In these activities both vision and the kinesthetic sensations from the eye-ball movements take part. He believed that in a tabetic who shows considerable incoördination a large part of the defect is due to the dependence of the individual upon the visual sensations and upon the sensations of eye movements, that, in fact, these two sensations act as a control upon the general body activities. As a corollary, there follows the conclusion that if the patient is instructed how to move the part or parts without looking at them, and is trained to move these parts without reliances upon the visual and visual-

motor sensations re-education is most readily accomplished. It is undoubtedly true that the limitation of the patient's attention to the movement in itself is a process of great value in the recovery of accuracies of movement. There can be no question that in the performance of many of our daily movements we do rely to a considerable extent upon vision. Nevertheless, even the most casual observations by the pedestrian of himself as he walks about will show that the dependence is not very great. He walks along the street, makes the adjustment to other pedestrians, opens a door, and carries on many other activities concerned in locomotion while he is looking into shop windows or at the traffic. The eye is available for use, but it is not used in the manner and to the great extent that Maloney believes it is employed. The experiment of Stratton, in which he was able to demonstrate the possibility of rapid education of a normally visual subject to compensate for the inversion of the retinal images, is an indication that compensation for certain visual sensations may readily be accomplished. The visual and visuo-motor sensations are not always depended upon. In some cases, however, the visual and visuo-motor sensations are important in bringing about the finer activities or finer coördinations which are important in our daily life. A simple experiment helping to demonstrate this is that of attempting to write one's signature with the eyes closed. Without the visual sensations the performance is irregular.

Another fact of interest to us in this connection is that the professional dancer and the acrobat

can frequently continue their occupations for a long period after the beginning of tabes dorsalis. When, however, an individual recognizes the necessity, but realizes a partial inadequacy, for the fine coördinations he may give up trying, and obsessed with fears of failure or of injury he will execute his movements more awkwardly and less accurately. With these individuals the giving up of their activities means the giving up of their occupations. If the onset of the disease is gradual the continued exercise in their occupations compensates for the loss of those afferent impulses which are present in normal people, and which help to bring about the proper coördinations. It is doubtless true that some patients can be trained best by having many of their exercises carried out when they are blindfolded. It is equally true that some patients recover more readily when they have both the visual and the visuo-motor sensations to assist in the control of activities. This is especially true for the fine coördinations in which the accessory sensations assist in normal people.

The exercises which have been prescribed by Frenkel are well known and need not be described in full at this time. For convenience the more important of these have been described in many texts, but references should be made to the more extended description in Frenkel's book to which the reader is directed.

Exercises recommended for these patients who are not able to sit or stand are carried out on a bed or the floor, and they are mainly of the simple type (flexion, extension, rotation), with some of the more important coördinated activities, such

as lifting one leg and placing the heel of that foot on the knee of the other leg. The floor or bed exercises are followed by those in a sitting or standing position when the subject becomes able to sit or stand. For those who are not bed cases the sitting and standing exercises may be used from the beginning. The main exercises of this kind are: those of (1) standing from a sitting position; (2) the elements of walking movements; (3) complexes of walking activities; (4) the gymnastic "dip" and "half dip"; (5) balancing, with and without support, and (6) trunk movements.

Although frequently it is recommended that the exercises be given twice a day in half hour periods, in many instances periods as long as a half hour are too fatiguing, and they should be shorter but may be more frequent. The ability—and the fatiguability—of the subject should be the guide. This is true for the character of the exercises as well as the length of the exercise periods.

In dealing with the tabetic the first essential is to get him in a relaxed condition, and to relieve him from the tension which is constantly present when he is carrying out his daily round of activities. This relaxation can best be brought about by placing him in a reclining position and by the use of gentle massage. When he is thoroughly relaxed the observations regarding his capabilities may then be begun. Variations in strength and accuracies of movements may be investigated as in any other case which requires re-education. Since, however, the tabetic is usually tense it may be necessary during the course of an examination or during the course of any re-education period to

require frequent reclining and massage periods so that the relaxation of the individual is kept at its greatest height.

In carrying out any movement, either for purposes of examination or of re-education, the attention of the patient should not be directed visually to the movement. It is not necessary to keep the patient blindfolded but his eyes may be directed to something in the room. This is important in order that he shall not know or cannot see how inaccurate his movements are. A cloth screen which can be placed before the eyes or a magazine which is to be read will advantageously give the instructor the opportunity of making his measurements and carrying out his preliminary exercises without the interference of the patient's visual sensations. By this means apprehension and fear are not produced or strengthened in him. It is a well known fact that when an individual, however skilled he may be, is carrying out a movement to which he is unaccustomed, this movement will be poorly performed. If the tabetic in whom the movement is usually incoördinate is asked to carry out an unusual movement it will be more ataxic. If at the same time this inaccuracy is appreciated through the visual apparatus it tends to "force" the subject. He feels compelled to check the movement and to force it into the proper direction. In doing this he uses much more energy than the normal man, and frequently the result is worse than if he is not permitted to look at the activity at all.

The special exercises which are carried out with the tabetic should be initiated with the in-

dividual in the supine position. These should then be extended to the position in which he is prone. He should be exercised in all types of movement, especially in those for which he has shown a lack of capability, until he becomes capable of carrying out these movements at command, accurately and quickly but without the aid of the eye. Next should follow movements of progression, or crawling, when the patient is on all fours. Then when lying on his back he should practise the simultaneous movements of the arms and legs; two non-corresponding members such as an arm and a leg; two corresponding members at a time, like the legs; the arm on one side and the leg on the same side; the arm on one side and the leg on the opposite side of the body; then the four members at once. These exercises are followed by similar ones in the sitting position until the subject acquires an ability to carry out all types of movements properly. The final step is when the patient is made to carry out all those activities in the standing position.

In the first periods of re-education it has been said that exercises should be carried out only in the prone or in the supine position. In subsequent exercises even though a patient is able to carry out many movements in the sitting or standing position it is mentally valuable to him to have some exercises conducted when he is lying down. If the patient has recovered his normal attitude towards the capability of movement, when he realizes that it is only a question of time and care before he can bring about all those actions which are necessary for him in his daily life it is fre-

quently encouraging to him to see what he is accomplishing. This point may be reached within the first week or two of his re-education after which it is no longer necessary to keep him from making the visual-motor associations for the control of his activities. In this respect it is important to keep in mind that the improvement of the patient as shown by careful measurements which are taken from time to time are much more important in determining the direction and the course of the treatment than theoretical considerations of the use or nonuse of the visual apparatus or of the importance of substitutions of the skin sensations for the so-called kinesthetic sensations.

In the training of the individual, attention must not be solely directed to the so-called locomotor apparatus for progression, handshaking, eating, and the like. The head and the eyes must not be neglected. Movements of these parts are not infrequently as ataxic as the movements of the legs, and the segments require training to some extent even though it may not be to the same extent that is required for the arms and legs. For the estimation of the head movements and to control the exercises which should be carried out, special apparatus is frequently needed. Apparatus for this purpose is frequently of considerable complexity in order that all of the movements of the head may be controlled. Expensive and complicated apparatus is not required. A convenient and easily constructed apparatus for this purpose may be made as shown in the accompanying illustration, Figure 64. This apparatus consists of soft iron wires made to fit the head like a cap, to which are at-

tached four wires about 4 to 6 inches long extending from the circumference back and front and on both sides, and another wire is attached at the point where the cap wires join at the top of the head. The subject is seated on a chair or on a stool and the instructor is seated in front of him. Behind the patient a screen is placed on which vertical and horizontal lines are

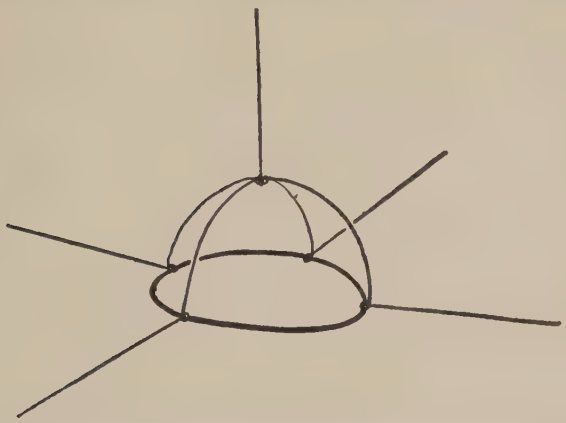

FIGURE 64. Apparatus for estimating movements of the head, and for controlling exercises.

marked. The instructor can direct the movements of the patient and observe on the measuring screen the extent to which the activities are properly carried out and at the same time he can direct the patient in the correction of the motor defects. When the subject reaches the point at which he can direct and correct his movements in front of a mirror the same arrangement is made.

The eye movements are much more difficult to exercise and to determine. The only certain

methods of determining the extent and direction of the eye movements is the photographic method. This is not especially useful in the carrying out of the re-education exercises, but in those cases in which the additional expense is not prohibitive it may be used to demonstrate the improvement. The apparatus is complex and will not be described here. Dependence must be placed almost entirely upon the observations of the instructor, but much of this observation is sufficiently accurate to bring about those directions which are needed by the patient. Exercises like the following are of value to bring about coördinated eye movements. The instructor should seat himself opposite the patient, holding in his hand a black rod the end of which is painted white, or an orchestral conductor's wand with a small lamp at the end. The patient is instructed to focus his eyes upon this point and to follow it in all of the movements which are made. The movements of the rod are then carried out in the three planes, and the eye movements are observed. Observations should be made on each eye singly, and on both eyes in their simultaneous activities. The rod should be brought from outside the visual field inwards and carried from inward outward. The movements should be from left to right, from right to left, from upwards downwards, from downwards upwards. The movements of the rod should be regulated so that some of the movements are slow and others are rapid. When it is found that the patient is capable of following the painted end of the rod at all times constantly and well, two rods may then be used, one in each hand

of the instructor. Varying combinations of the positions of these rods may be used. The subject should be instructed to focus on one, but at the word of command quickly and accurately to direct his gaze to the other. When these activities can be carried out without great difficulty the patient should then be instructed to combine the movements of the eyes, and the head so as to bring about convergence and accommodation by the use of these two parts. Here the procedures will vary both in number and in quantity in accordance with the capability of the individual to learn. The instructor must frequently exercise his ingenuity to bring about experimentally those conditions to which the patient must adapt himself in his daily life.

Exercises for the legs are of greater importance to the individual at the beginning in order that he may be able to walk. Too exclusive attention must not be directed to these segments, for it is equally important that the subject should reacquire the ability of dressing himself, of eating, of writing, and of using his hand for those numerous activities in which the hand must be employed. When he has been re-educated to the extent that he is capable of walking on a smooth surface, he should be exercised in lifting his leg to appropriate heights and to stand steadily when mounting steps. He must be taught to walk on an uneven surface where the unevenness is a slant to one side or forward or backward, or where there is an actual unevenness such as may be produced by variation in the heights of different parts of the walk. The latter can be accomplished

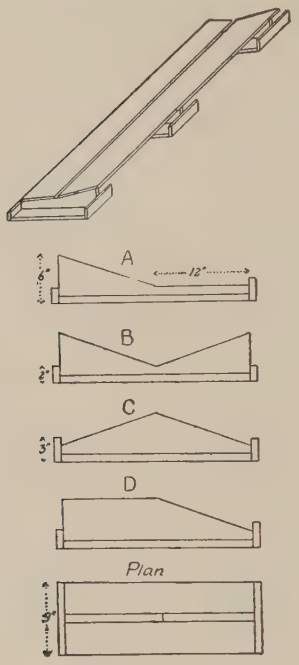

FIGURE 65. Diagram illustrating apparatus in re-education of walking movements which have been referred to in the text, two of which are shown in operation in figure 66. The large figure at the top shows one of these walking tracks arranged with one part level and the other part on the decline. Diagrams A, B, C, and D show side views of the supports required for different tracks, D representing one used in the construction of the tracks illustrated in the large figure.

in the best fashion by exercises in walking over an uneven lawn or a plowed field. The exercise in which the subject is walking on a slant can be carried out in the re-education institute by using heavy wide boards which are slanted in the different directions which are needed. For office or home use these appliances are constructed very simply by using two or more boards placed upon special supports which are wedge-shaped and of different thicknesses at the sides. Diagrams of some of the ways in which the apparatus can be made are shown in Figure 65. Two boards, 1½ inches thick and about 10 feet long, are required, and three supports of each kind that are found most useful. The illustration shows an arrangement in which one foot is used on the level and the other foot on an inward incline. The smaller diagrams show de-

tails of the construction of four kinds of supports made for exercises with: (A) one foot level, one foot on incline; (B) both feet on incline; (C) both feet on decline; (D) one foot level, one foot on decline.

Other accessory apparatus may sometimes be

FIGURE 66. Illustration of two walking tracks in operation. These tracks are too narrow for many patients. They should be broader so that those with marked incoördination may use them. Compare the diagrams in Figure 65. From McKenzie.

needed to help to overcome the hyper-extension which is sometimes present. The bowing at the knees can be overcome or can be helped by a simple bandage, an elastic one being sometimes sufficient. Sometimes when the hyperextension is very great it is necessary to use appliances in the form of braces which are more frequently needed in the re-education of cases of spinal paralysis, like

those following poliomyelitis. In general, however, supporting appliances needed for the tabetic are few in number. The fewer that are used the more confident in his own ability does the patient become and the more quickly does he recover his voluntary control. During part of his exercises, it may be necessary to supply the patient with crutches, but these should never be used if a cane will accomplish the purpose. During the re-education exercises with some subjects a cane may be needed, but this should be discouraged as much as possible and it should be discarded as soon as practicable. If it increases the self-confidence of the patient, it may be used when he walks abroad among crowds or in unusual situations. What is needed above all is to get the patient to depend upon himself and to use all the means at his disposal for the purpose of producing the movements of normal quality and extent. Too great dependence upon his eyes, too great dependence upon bandages or splints of any kind or upon crutches or canes or other accessories is not to be permitted. The patient must be taught to move freely and confidently. If a support of any kind is needed it should be provided but this should be determined only after careful examination. The support should be prescribed in exactly the same way as the exercises. Moreover its use should be prescribed: when it is to be used; how often; when it is to be discarded; when it is to be replaced by something else, and whether it is to be used continuously or not at all.

Not infrequently the tabetic shows muscular weakness. This has already been described as a

weakness due largely to inactivity. It is due also to the perverse idea that he is not capable of moving. Although the difficulty may be mental to a very great extent, tests with the muscle balance like those for the poliomyelitis patient are advisable. They may show an objective weakness and if this is suitably shown, exercises should be prescribed to overcome this defect. The strength of the muscles can be partly brought back to the normal condition by massage and other passive exercises as well as by active exercises without or against resistance. A convenient method of increasing the strength of a muscle group in the condition of locomotor ataxia and in those other states which show irregularities in activity is to have the patient execute a movement of a certain character to the greatest possible extent and to hold the limb in that position as long as it can be held. This results in fatigue, but fatigue is normal and is not to be entirely discouraged. It should not be permitted to go to the extent that the muscle or nervous system is exhausted. It will be found that at first a patient is incapable of holding a certain position for more than a few seconds. Gradually, however, the strength of the muscle increases and the continuation of these exercises brings the muscles to the point that the posture can be held for a minute or more.

In the execution of the movements that are prescribed they should be carried out slowly at first, but with increasing speed in accordance with their characters and as the training progresses. Until the necessary movements can be carried out with accuracy, which, as has already been men-

tioned, means sufficient speed, sufficient strength, and sufficient extent, all of the elements sufficient in amount that they are appropriate to the individual movements, the patient cannot be said to have completed his re-education.

It has been mentioned and will be mentioned again in relation to other re-education cases, that it is important that the exercises or performances of the individual shall be carried out not only in the presence of the instructor but under conditions in which other observers are present. This will tend to give the patient confidence in his ability to walk in public. A good procedure to follow, after the patient has recovered from the fear and has attained a considerable amount of personal confidence in his ability to move the various parts of his body, is to have two or more subjects in a class so that each becomes accustomed to a number of individuals about him when his exercises are being given.

CHAPTER X

CEREBRAL PARALYSIS.

In cerebral paralysis the outstanding feature is that of inability to carry out movements with one or more bodily segments. In addition to this primary inability, in those cases in which the paralysis has existed for long periods of time it will be noted that certain muscles are tightly contracted. The limb of which these muscles are a part is not held in a natural position, but it is rigid and flexed. The muscular rigidity and the flexion just mentioned, which together are called contracture, begin in some instances within a few days after the destruction of the cerebral cells or connections. The early appearance of rigidity is usually in the cases where there has been a destruction of the cerebral cortex. In other instances the contracture may not develop for weeks. The contracted state which develops late is most frequently associated with subcortical lesions of the motor, or pyramidal, tract in some part of its course from the internal capsule downwards. In the long standing cases, in addition to the paralysis and contracture there may be shrinkage of the muscles. When this atrophy is investigated it is found to be dissimilar to that produced by lesions of the lower neuron (as in poliomyelitis), in that the muscles do not completely waste

away, and in that its physiological reactions, especially noted in connection with electrical stimulation, remain normal. Examination of the muscle cells under the microscope in cases of cerebral paralysis shows that they have retained their normal appearance, and that they cannot be differentiated from the cells of unparalyzed muscles.

The three conditions, inability to move, contracture and slight atrophy, must be dealt with in the re-education process. In carrying out the re-education procedures it is not necessary to direct a therapeutic attack against each of these defects separately because those procedures that are most useful work to overcome the defects simultaneously. For our purpose here, however, we may deal with the conditions separately and describe the methods of use of the re-education processes which can be applied to overcome each defective state. While it may be anomalous to state the matter in these terms, the best way of describing what must be done to overcome the paralysis is to say that the patient must move, he must make voluntary movements. By this is meant that the patient can help to overcome and actually overcome the paralysis best by his own voluntary efforts. By carrying out those procedures which are intended to overcome the contracture and the atrophy, he will be helped to this end.

First, let us consider the atrophies, which are due to disuse. The atrophies can be easily overcome by those measures which are commonly used to increase muscular tone and strength. The individual muscles must be exercised, by massage and other passive movements, to compensate for

the voluntary disuse. In the examination of a patient it will be found that some muscles atrophy more rapidly and more completely than others. The quantity or amount of atrophy varies in each case, depending upon the duration of the paralysis and upon the care given to the patient. Most frequently the greatest amount of atrophy is located

FIGURE 67. Showing the atrophies and contractures which may be encountered and which must be dealt with in many kinds of paralyses. This illustration shows the conditions due to a bullet wound with ulnar paralysis. From McKenzie.

in those muscles which make up the thenar and hypothenar eminences of the hand, in the deltoid muscle, and in the tibial-peroneal group in the leg. In dealing with the atrophy efforts should be made to increase the circulation, and thus the food supply and elimination, of the muscle. This can be done partly by the alternate application of heat and cold, as well as by exercises. The exer-

cises may be given partly by electrical stimuli and partly by manipulation. The manipulations are those that are commonly described as passive movements and massage. The use of these measures should be carefully controlled. Too much stimulation is frequently worse than none. Care must be taken that the manipulations and massage do not unduly fatigue the muscles, which condition is very apt to exaggerate the disability. It is best to massage the individual muscles not longer than one to two minutes for each at the beginning of the re-education, and to increase this time slowly and gradually so that it reaches the limit of about three to five minutes for each muscle. By other manipulations the parts to which the muscles are attached and on which they normally work are moved in all possible directions.

The contracture is due to the strong pull about a joint of a larger muscle which is not balanced by a weaker antagonist. This imbalance of a larger muscle produces in the upper limb adduction of the arm and flexions at the elbow, wrist and fingers. In the leg there is usually extension of the foot, and there may be flexion at the knee. The distribution and the degree of contracture are slightly different for individual patients. When a patient who exhibits very marked contracture at the elbow is examined it may be found that the angle made by the forearm and arm, the elbow joint being taken as the center of rotation, is 60 degrees. The normal position is 180 degrees, or a straight line. The first thing to accomplish is to straighten the arm. The tightly contracted shortened flexor must be stretched and relief given

to the lengthened extensor. The contracture is at first very difficult to overcome. At first straightening can scarcely be done by more than five to ten degrees without causing the patient considerable pain. Resistance to manipulation is immediately perceived. However, means are at hand which when properly utilized will overcome the increased tonicity and contraction. The two methods which I have found most useful are as follows: the hand is firmly grasped by the operator with his two hands, the whole arm of the patient is vibrated very rapidly and with very little excursion, and at the same time traction is applied to straighten out the fingers, the wrist and the forearm. At the first attempt the contracted fingers may not be moved much, and the flexion at the elbow may not be much changed. After a brief rest, this may be repeated, with increased success. The same manipulation may be made with the same segment several times, each time usually with a better result. After the contracted muscles are relaxed in this way the extended arm is brought over across the chest to a more completely adducted position very slowly, and it is then moved backward very slowly to an abducted position. Movements of this kind are carried out in all directions about the shoulder joint and the elbow. It takes considerable experience to make the vibratory movements fine enough and quick enough to get the best effects. It has been my experience that the effects are most easily produced when the vibratory movement has the character of a fine tremor where the individual contractions and relaxations are almost imper-

ceptible. The explanation for this is that a quick and extensive pull on a contracting muscle tends to increase its contraction, whereas slight stimuli help in relaxation, especially if the stimuli are rapidly repeated. Each slight pull tends to extend the contracting muscle, very slightly to be sure, but with the great number the stretching is gradually accomplished. This vibration causes no pain to the patient, but the quick extension is accompanied by pain, and is strongly objected to. If the part which has been vibrated is permitted to rest, the extension may persist for a relatively long time, ten minutes to a half hour, but gradually the limb assumes its position in contracture.

After the relaxation has been produced in the manner described, other passive exercises of the parts of a segment are to be carried out. It will be found that after a few of these exercises are given the flexor muscles have a tendency to shorten again and to go back to the condition of contracture which was noted at the beginning of the treatment. When there is a recurrence of the contracture the vibratory movements must again be carried out, and then passive exercises can be continued until we again get the tonic activity. In addition to the vibratory method, gently stroking of the muscles which are contracted will occasionally bring about a sufficient relaxation. If this stroking (effleurage) is carried on prior to or following the vibratory exercises it will tend to help to overcome the contracture. By itself effleurage, however, has not been found to be as efficacious as vibration and its value in the over-

coming of a contracture is as an accessory method to help vibration.

The weaker muscles may be exercised by kneading (petrissage) and by striking (tapotement). Those muscles which are tightly contracted are not to be stimulated in any way. They are already hyperexcitable and stronger than the opponents, and whatever is done to them should be to lessen their irritability and strong contraction. The application of heat in the form of stupes, at about 110° F., will help to relax those which are contracted so that the segment under treatment may be more readily worked with. The extensors and abductors have in general a lessened irritability or excitability. Active massage should therefore be directed towards increasing their excitability and their power. If they can be increased in strength they will by themselves balance the adductors and flexors. In this way the contracture may be partially compensated for or even overcome. It is also of importance that the irritability of the extensors shall be increased so that when slight nerve impulses come down from the central nervous system to them they will be able to contract against their opponents. Both of these results must be sought, on the one hand an increased strength for the weaker muscles (which may be partly done by decreasing the irritability or strength of the stronger) and an increased irritability so that they shall be able to respond more readily with a contraction to the nerve impulses.

Another means of increasing the irritability of the muscles is to vibrate, gently but with a firm

pressure of the finger, the muscle at the point where the nerve enters it. I usually use the medius finger over the point of entrance of the nerve into the muscle tissue but in some cases where a greater reaction can be obtained, I stimulate slightly above or below. In a man in whom the contracture has been of long standing, and frequently also in the paralytic of recent origin, the first or second vibration of the nerve-muscle connection does not appear to have any great effects. If, however, this is repeated daily the vibratory movements bring about marked contractions of the muscles which resemble the movements in clonus. At times also they produce pain. Both pain and clonic activity are indications of an increased excitability, which it is desirable to produce if the slight nerve impulses are to have any great effect.

So far there have been described those methods of dealing with the individual muscles or muscle groups by purely manipulative means. I have not utilized to as great an extent as could perhaps be used those mechanical means which have been found useful replacements for hand manipulation in vibration. Vibratory machines, including the ingenious but complicated Zander apparatus, have been successfully used by many to overcome certain muscle defects. For some patients they have great value but there is a disadvantage in using these modes of manipulation in that the patient is not usually watched all of the time and there is the danger that many patients will be treated at one time, and sufficient attention be paid to none. The possibility of over stimulation is always

present. With hand manipulations properly carried out the experienced operator can gauge the conditions of the muscles. By palpation the operator can determine whether or not the muscles are relaxing or contracting, whether they are becoming fatigued or are over stimulated, and a variety of other conditions respecting tonicity which cannot be determined in the application of vibratory apparatus or by strapping the part to a Zander exercising machine. A similar comment may be made with respect to the electrical stimulation of the muscles. Much good may come from proper stimulation of the muscle by electrical means, but so far as I am aware there are no good scientific data to indicate the superiority or inferiority of this method of stimulation as compared with hand manipulation. The apparatus commonly used for the electrical stimulation of muscles is painful to the skin and much of the good effects of muscle manipulation is lost because of the dread of the patient and his consequent shrinking from this form of treatment. The Bristow coil has been advocated and successfully used for muscle stimulation in other classes of patients, and it seems likely that the objection to the use of the induced current because of the painful experiences of the patient may be overcome by the use of an apparatus of this kind.

In the paralyses of peripheral or spinal origin, supports or braces of different kinds have great value. In the cerebral paralyses they are of little use. They do find application for the support of over-stretched muscles. In the form of splints they can be of value in overcoming contractures.

After a contracted segment has been relaxed, I have frequently used a splint to keep the part in a normal position for a time. This has the danger referred to in connection with the use of vibratory appliances, in that the state of the patient's muscles cannot be known at all times. The use of a splint should be restricted at first to a few minutes, and in cases of long standing contracture where difficulty is experienced in overcoming this abnormality the splint may subsequently be applied and left on for several hours. The value of the splint is to rest the over-stretched extensor muscles. Better than the rigid splint are those which have springs. For the fingers and wrist, for example, I have used long corset steels, one for each finger and the five brought together for the wrist. These act as partial supports. All bracing and splinting have only temporary values.

The means which have been described are subsidiary, accessory, secondary, and preliminary, to that of getting the patient himself to move. At all times, even at the beginning of the course of re-education exercises, the patient must be urged to attempt to carry out certain activities by himself. At first, because he has been unable to move for some time, he will strenuously deny that he is capable of moving the part which you ask him to move. Perhaps he will say that he has tried and tried, and tried again, and has found it impossible. Urging that he do this will, however, frequently get him to recognize that a certain amount of movement is possible in parts which he thought were completely incapable of voluntary activity. When this point has been reached, the beginning

of his re-education or motor rehabilitation has begun. I have had numerous experiences with individual patients which illustrate this point. The following may be taken as a typical example, although it should be understood that in individual cases the manipulations to be used and the activities to be demanded may vary from case to case. A young man hit with a high explosive shell had a complete hemiplegia involving the face, arm and leg segments. This state had persisted for a period of about nine months. His arm, unlike that of the majority of cerebral patients, was abducted, and there was a marked flexion at the elbow, wrist and fingers. He entered the room hobbling with a cane which he held in his right hand. I ordered him incisively to put down his cane and take a seat in a chair which was about twelve feet distant. He told me he could not walk without his cane, but I insisted that the cane be laid aside and that I knew he would not fall if he were careful. He did as he was commanded and found that he was capable of walking, awkwardly to be sure, but unassisted by the cane. He reached the chair and sat down. I thereupon began the manipulations for the relaxation of the muscles of his arm. After having straightened the arm segments so that the contracture at elbow, wrist and fingers had been overcome, and the arm was in a normal adducted position, I ordered him to take hold of my hand tightly and squeeze it (a flexion movement). He denied that he could do this, and asserted that he had tried to move his fingers ever since the time of the accident and his subsequent operation. I insisted, however, that he

could do it, and on further urging he discovered that there was a certain amount of movement possible. Several times I have spoken of these cases as being paralyzed, or as remaining paralyzed, on account of a habit of inactivity. While it may be scientifically inaccurate to speak of a habit of inactivity, from experience it is apparent that these patients have been permitted to be inactive, because they have a certain amount of recognized incompetence. On the other hand they may also have a competency of which they are not aware.

As soon as a patient finds there is a capability of carrying on certain movements, his tendency is to continue to do these movements frequently and sometimes continuously. The recognition of his unexpected competency and his eagerness to improve have good and bad features. The encouragement of the patient when he finds that there is a capability of movement is the best feature, his over-anxiousness to return to a perfectly normal state is the bad feature. A few words may be said in explanation of the latter. In paragraphs above I have frequently called attention to the fact that the muscles must not be over fatigued. When the patient most anxious to be active finds that he is capable of making certain movements, the tendency to exercise too much may overcome beneficial effects from other re-educational procedures. He is over anxious to get well and therefore too active; neuro-muscular fatigue beyond the point which is beneficial may be the result. In many patients a lack of improvement from day to day or week to week can be traced directly to their

hyperactivity. The over-activity results very quickly, because they are not normal, in a condition similar to that in athletes which is known as "staleness." At the beginning of their recovery many patients must be continually warned to make no efforts towards self-improvement beyond the exercises, in quantity and character, which have been prescribed. In this respect the patient must be dealt with in much the same way as a patient undergoing treatment of a chemical nature. The use of strychine, glandular extracts and other chemicals may be beneficial when given in suitable doses, but when these chemicals are left with the patient to take as he pleases, and in such quantities as he cares to take, the effect is frequently the opposite of that which is desired. Too much emphasis cannot be placed upon the regulation of the quantity of treatment, and it has been my experience that small doses are infinitely better than large ones. In this respect a good rule to follow is to give homeopathic doses frequently rather than a single large dose at infrequent intervals.

CHAPTER XI

SPEECH DEFECTS.

For convenience we may divide the numerous kinds of speech defects into two general classes: the functional, and the organic. The latter consists of two kinds, not in reality distinct, the paralytic and the aphasic. Many of the disturbances of speech are not exclusively of one class but frequently are combinations of the two. In some instances there is difficulty in determining how much of each of the two elements is present. In many cases there are combinations, difficult to differentiate, in which apoplexy brings about a condition of aphasia plus a paralysis of the facial muscles. There may be added to this a functional disturbance not due to the brain disturbance. The method of dealing with these cases must necessarily differ in accordance with the character of the defects.

Without entering into a discussion, which would necessarily lead us far afield, regarding the causation of the so-called functional speech defects, we may take for granted for our purposes that there are two kinds of this class. One of these is due to certain mental disturbances, or conflicts in the Freudian sense. The other kind is caused by faulty habits, or it consists in inaccuracies or incoördinations of those activities which are needed

for correct and fluent speech. The incoördinations may be matters of improper acquisition or they may be disturbances of acquired speech. In accordance with the point of view one would deal with some of these cases by means of psychological analysis or psychoanalysis, and others would be dealt with by correcting the faulty habits which are apparent. It is not always possible to determine that one of these disturbances is purely psychogenic or purely a matter of habit formation. A careful analysis may reveal that both of these two conditions are present and how much each is to be dealt with.

Some speech disturbances are purely habit states which are normal for the subject, however much they differ from the speech of others. It is almost unnecessary to say that colloquialisms, provincialisms, and the regional speech characters of individuals are perfectly normal for them. They are recognized by others as peculiarities, and they are commonly believed to indicate a faulty or defective habit production. The slurring speech of the negro, the nasal twang of the northerner, may have some relation to the anatomical and physiological conditions of the organs of speech, but experience shows that most of these peculiarities are due to the way in which the speech function has been acquired. The sounds which the child makes are those which he hears others make. He imitates what he hears and he forms a habit of speech which is normal for that community. In a community a few hundred miles away the same speech sounds do not result in those reactions which are readily understood. In

these cases, therefore, we may rightly consider that we are dealing with functional speech differences.

From what has preceded we are justified in saying that the proper method of treatment is to change these peculiar speech habits into those which are less peculiar to the environment of the individual. Many times this is accomplished by the individual himself without spécial training under the direction of others, but the financial success of numerous speech institutes and teachers of elocution indicates plainly that many others need more than their own individual efforts to overcome the expressional habits which have been acquired in early life. In general two correctional methods are used. One of these is related directly to the movements of the various parts of the vocal apparatus. The efforts of the instructor are directed to training in those correct movements which are necessary for the production of the combinations of tone that may be readily understood by most people. To produce the result the attention of the patient is first directed towards the production of certain individual movements. These are mainly the movements of the lips, the tongue, and the breathing apparatus. After the simpler movements can be controlled training is directed to the combination of these individual movements into the complexes which result in the sounds. Some instructors start with the individual vowel sounds, then the combination of these sounds with the consonants, and finally to words and sentences. The other method is to start the individual in the production of sounds which

are like those which he hears. Less attention is directed towards the individual movements but attention is directed towards the misdirected parts of the whole, and to training those activities which are of obvious social importance.

These two methods may be compared rather definitely with the methods of teaching swimming. In one the individual is taught the elements of swimming movements, at first those of the arms, then those of the legs, thirdly the combination of the two. Finally he is allowed to go into the water, and he is instructed to bring about the combination of those activities which have been individually acquired. By the second method the individual is placed in the water and, although protected through its shallowness or supported by a rope, he is urged to execute simultaneously with arms and legs those movements which are necessary to keep him afloat and to propel him forwards.

With the timid the first method is usually more successful, with many others the second method results in an early acquisition, and finer details are subsequently learned. In dealing with the functional speech defects it is sometimes necessary to use both methods. These may be called respectively the part method and the whole method. In those cases in which the tongue is so long that it results in the condition known as lisping this must be dealt with as an individual type of exercise plus the exercise of all of the muscles simultaneously. In stuttering and stammering conditions, breathing exercises plus the exercises for formation of the different vowels, sibilants, aspir-

ates, etc., are given, and to these are added the exercises in the complex movements necessary for the production of coördinated and current speech.

Those cases in which evidence is at hand to warrant the belief that the speech disturbances are due to mental traumata or complexes in the Freudian sense may be efficiently dealt with by means of psychoanalysis. This is not the place to detail these methods and to explain the results. For the better recovery of many patients of this kind there must be added to the psychoanalysis special speech exercises such as are recommended for those cases which are not purely mental, i. e., in the sense of being due to complexes and conflicts. For some individuals of this group the direction of the speech exercises must be those of the individual movements, and for others the exercises should be in the complex activities of all of the muscles of phonation.

In carrying out exercises which are recommended it is not infrequently found that the individual is capable of making the proper adjustments when he sings, whereas the speech adjustments in ordinary conversation are not well produced. This fact points to the value of the utilization of singing as a subsidiary method in certain cases. Music in connection with verbal exercises is valuable as an adjunct, but the emphasis must not be placed on the music. It is not necessary that a tone should be held or that a tune should be followed by the pupil. In many instances the special value appears to reside in the condition that the exercises are carried out in a rhythmic, music-like manner. After speech difficulties are

overcome by these means the music may be replaced by a metronome. The tune gives way to simple rhythmicity. This accessory apparatus may be gradually dropped and the individual carried on by the ordinary methods of speech training.

At this point attention should be directed to the overcoming of a difficulty which is encountered to a certain degree even among normal people. This difficulty is not of such character to demand frequent attention of the re-education expert, because it is so common, and because it is thought to be normal. This is the fact that under certain conditions the individual is able to speak correctly and fluently while under other conditions he stutters, stammers, hesitates, or talks almost incoherently. He may chop off a sentence before it is finished, beginning a new one, and ramble on in an illogical manner or with an indistinct mumble. In conditions of this character the important point is the emotional condition of the individual. Some men talk fluently, freely, coherently at all times, others only when sitting with a half dozen people. Some when compelled to get to their feet to address more than the accustomed number, or to talk to people whom they do not know, find their thoughts fly from them, and their speech is hesitating, stammering, and a series of disconnected remarks. This speech difficulty can be overcome by practice. In those needing re-education one will not infrequently encounter exaggerations of this state of affair. The patient may be re-educated to the point that he can speak fluently and well and he can read without hesi-

tation to the instructor. When, however, he enters a social gathering, the environment produces in him a certain emotional condition which results in a reversion almost to that state for which he consulted the re-education expert. To overcome this is sometimes, but not always, a difficult matter, since it depends upon the control of the emotional reaction of the individual towards groups. Many times after the patient has been sufficiently re-educated to carry out his speech reactions in a normal manner in the presence of the instructor, the exercises must be continued in the presence of one or two or more individuals. Or, a small audience must be gathered from day to day so that the patient becomes accustomed to other people as customary stimuli in his environment. In extreme cases, but seldom, it is necessary that the instructor shall accompany the pupil into some social gatherings to furnish his moral support. This can be put in other terms, that the instructor shall provide the particular stimulus which is needed to bring about properly coördinated speech. These added procedures must be applied with great care, because they are apt to lead to great dependence upon the instructor, whose efforts must be directed towards the production of independence.

The second large group of speech defectives is one which is dependent upon paralysis of parts of the vocal apparatus or upon accessory disorders. The more important accessory conditions are the tremors of the lips and tongue, which prevent suitable movements. Two general methods of dealing with these cases are also to be noted. The first of these is directed towards the production of com-

pensatory movements which will enable the individual to adjust his controllable muscles so as to produce sounds which are distinguishable. The second is to give exercises slowly and demand accuracy. The tremors are due mostly to general nervous conditions. The paralyses which may give rise to speech defects are of two kinds; that due to lesions of the lower motor neuron where the seventh or facial nerve has been sectioned or degenerated, the second in which paralysis of the upper motor neuron type is due to the destruction of the lowermost portion of the precentral cortex or to an interruption of the nerve fibers as they pass downward towards the nuclei controlling the muscles of phonation.

In the peripheral paralyses relatively little can be done provided the destruction of the nerve is not followed by regeneration, or cannot be compensated for surgically by nerve anastomosis. If either is accomplished re-education is largely a matter for the individual after the nerve has been regenerated. In those cases in which the paralysis is due to a degeneration of the nerves little need be done beyond that of seeing that the patient does not acquire bad habits of speech which may result in a permanent defect. How poor speech may follow this condition can be understood well by analogy. In looking at the walking of a man who has had a broken hip or a degeneration of the sciatic nerve, with a subsequent complete repair of the bone or a complete regeneration of the nerve, peculiarities of movement will be detected. During the time that the leg of the individual is in an abnormal condition either because of the

fracture or because of the nerve degeneration, walking must be carried out in a peculiar manner. But, long after the repair of the fracture, and long after the functional return in the nerve, this method of walking which is entirely unnecessary may be continued. In other words, during the abnormal period an abnormal method of reaction is carried out and this has led to a special kind of walking habit. After the nerve regeneration or bone repair this reaction is not necessary and the bad or ineffectual habit must be replaced by a more normal habit. So also after the regeneration of the nerves concerned in the movements of the lips, cheek and tongue. After the muscles are movable voluntarily many bad habits of speech may persist. These have become habitual and are unnoticed by the subject. They are, therefore, not overcome by himself but they must be corrected by suitable exercise directed towards the production of movements of those characters which will result in normal speech.

In those in whom the paralysis cannot be overcome, and this is the case in which the muscles have degenerated and also in some cases of cerebral paralysis, it is necessary to attempt to bring about compensatory movements which will tend to overcome the abnormal speech state. Regardless of what may be done the speech will remain indistinct and bad in many of these cases because sufficient compensation cannot be brought about. With other subjects, however, and these make up a very large proportion of the cases of paralyses, compensatory movements can be produced which largely cover up the paralyses. These compen-

satory movements can be described when they occur, but they cannot be predicted for individual patients. All that one can do is to carry the pupil through those special exercises for the sounds which are difficult for him. In many instances the results are discouraging at first but they should be carried out regularly until their futility is apparent or until a sufficient amount of compensation has taken place. Many in whom the paralysis is permanent and who have been re-educated speak well, and only a careful observation will determine that the accessory movements have not entirely compensated for or overcome the defect. In these re-educated individuals speech is recognized to be different from the normal,but it may appear provincial rather than paralytic.

It has already been mentioned that special re-education exercises are of value in those in whom there are involuntary movements of the tongue and lips of the nature of tremor. Much can be gained in those cases by systematic, carefully controlled exercises. The exercises must be carried out slowly, great care being taken by the subject in clear enunciation. In those diseases which are rapidly progressive, as in general paralysis of the insane, it would be useless to attempt re-education of speech. In many others, and they make up a large number, where the disease has been arrested the attempt can be made successfully.

The third large group of cases is that group known as the aphasias. More than a dozen different kinds of speech defects are grouped under the general term aphasia, and for descriptions of these individual conditions and of the varieties

of defects which are to be found reference should be made to those books which deal descriptively with this subject. In general, however, there are two main types of aphasic individuals which have to be dealt with. Probably all kinds of aphasia are fundamentally the same, but it is usual to make two large divisions. The first of these is the inability to bring about those coördinations of activities which are needed for the production of sounds, and the second includes those cases in which the sounds, emitted by another, which are matters of speech, are not taken in. In other words, it has been usual to differentiate the aphasic of a motor type from him who is of a sensory type. In practice, however, it is unusual to find a pure aphasia, one which is entirely motor or one which is entirely sensory. In my experience with these patients, I have not found one whose difficulty was entirely motor or one whose difficulty was entirely that of understanding, viz. sensory. Those with whom I have been concerned have been mixed, in that there were symptoms of motor inabilities or difficulties, and symptoms of sensory inabilities and difficulties. Whether or not, as some investigators contend, all the aphasias are primarily sensory aphasias, to which in some patients there may be added certain motor deficiencies which give rise to the condition called motor aphasia, need not be discussed at this point. In practice it is well to make the distinction, however much alike they may appear from theoretical considerations. It is necessary to know how to deal with these two aspects. The direction of therapeutic measures is dependent upon the pre-

dominant character of the defect, whether this is largely sensory with a small amount of motor or largely motor with a small amount of sensory disturbance.

Before dealing with the aphasic it is necessary to analyze the condition and to determine so far as practicable the fundamental defects which are present. It would be absurd to attempt to teach an individual who exhibited an inability to read, which is a sensory aphasia of a visual character, if the individual is mentally blind. If in other words the subject cannot take things in through his visual apparatus much time will be unnecessarily lost. It is also absurd to attempt to teach an auditory aphasic to understand spoken language if that patient exhibits such defects of hearing as to indicate a deafness. Moreover, it should be said that the motor aphasic who exhibits paralytic symptoms must first be dealt with as a paralytic and whatever motor recovery can be brought about should be produced prior to or concomitant with the active attempts at speech re-education.

The motor aphasias are of different types, only two of which are important for our present consideration. There is that motor aphasia in which the individual is unable to use appropriately the muscles of phonation. This is more commonly found and is usually given the general name of "aphasia" or aphemia. An equally important defect is that in which there is an inability to express one's self in writing. This is called agraphia. In sensory aphasia also we find divisions or distinctions, there being those aphasics

who take things in through the eye very little or with difficulty, and those others who take things in through the ear with difficulty. Other forms of aphasia and combinations of these, are found, but in dealing with re-education we shall confine ourselves to the four forms which are the most frequent; namely, aphemia, agraphia, visual aphasia, and auditory aphasia.

In dealing with the aphemias it has been advocated by some experts that the patient should be exercised in the formation of the movements which are necessary for the production of the individual sounds that comprise words and sentences. The basis for this recommendation does not appear to be the analytic study of aphasia, but rather the analytic study of language. It has been my experience that it is just as easy for the patient to start with simple combinations of movement which make up the relatively simple word sounds, as it is to start with the individual vowel sounds, their subsequent combinations with the consonantal sounds, and finally to go on to the complexes which we speak of as words and sentences. The advocacy of the utilization of exercises on the simple sounds has been limited to the conditions of motor aphasia, but not those of sensory aphasia. If the procedure is of great value in one type it should also find great use in the other. Its usefulnes appears to be mainly in the re-education of those in whom the aphasia is accompanied by paralyses. It corresponds with an analogous procedure in the re-education for writing.

If the patient does not exhibit a paralysis,

and can use hand and arm well, but does show an inability to write, numerous exercises can be given to produce a return of the writing function. Among the first exercises the patient is instructed to copy writing or print. This will be done very slowly at first, sometimes with gross errors in the formation of the individual letters or with letter omissions. Persistence in the exercise, especially when there is the association of the copy with those things which have an interest for the patient will produce those habit reactions which are desired. Later these activities can be developed into voluntary writing by combining the stimulus of the written copy with auditory stimuli of the voice of the instructor repeating the words to the pupil. Or if the patient can read either silently or aloud he may use this as an additional stimulus for reinforcement of the written or printed paper before him. When the subject is found to have difficulty in the copying of individual letters special exercises for hand and arm movements may be given advantageously. What is sometimes lost by these individuals is not the grosser activity but finer coördinated movements, or associative movements. The exercises may take the form of those penmanship strokes which are found in writing exercise books. These may be frequently repeated until they can be well performed, and later they can be used in combinations. It is advantageous in most cases to have the individual make his written copies large. The strokes or the letters may be from one to two inches high, rather than the one-eighth inch size or less which is predominant in normal people.

Special exercises in steadiness, such as those which have been used to obtain control in locomotor ataxia or in tremors, are also advantageous and may supplement with great benefit those exercises which are directed primarily to the writing activity.

The cases of aphemia must be dealt with differently. The individuals who are incapable of speaking must be taught to combine the activities of the lips and tongue, and other parts of the speech apparatus, into coördinated movements which will result in words and sentences. I have usually begun by giving these patients either an auditory or a visual stimulus or the two in combination to produce the reaction. The visual stimulus may be of several kinds; a printed word, a written word, and a picture or an object which corresponds with the words. We may show the individual the picture of a cat, the printed word cat, and simultaneously the word cat is written for him. He is then asked to say the word or to read it or to name the object in the picture. If he is unable to do so, or if he does it badly, he is given in addition the auditory stimulus of the word cat, and he is urged to make the sound which corresponds.

In many instances the patient is unable to do this immediately from the stimuli which are presented to him in this way. The instructor may be compelled to add to his procedure other stimuli to bring about the necessary activities. He directs the patient to look at his, the instructor's, lips and tongue when the word is being said, and then tries to get the patient to form with his own

mouth the proper positions for the production of the sound. At times also, just as in cases of partial paralysis of the tongue, it is necessary to manipulate the parts, to take hold of the tongue with the fingers, to place it in position and then arrange the lips in proper positions to show the patient what is to be done. The instructor may then urge the patient to hold those positions while breathing and make the sound. The use of a wooden tongue depressor is frequently of value in the placing of the tongue, especially in its manipulation beyond the tip. Frequently also the tongue depressor or a small piece of wood can be inserted between the teeth to show the patient how the jaws should be held. If additional pieces of thin wood are used for the purpose of placing of the tongue the sounds can be produced. This is tedious both for the subject and the instructor, but its greatest value lies in those cases in which there is difficulty in the enunciation of a few sounds.

After the patient has once learned to carry out certain of these movements a useful method is to require that all of the movements be carried out in front of and observed in a mirror. A magnifying mirror has certain advantages and can be used with great benefit to the patient but it is not necessary. The instructor should sit opposite the patient but not more than three feet away from him, in order that careful observations may be made of the movements made by the patient in carrying out the speech function. Each time movements are correctly made, the patient should be encouraged. Each time incorrect movements

are made his attention should be directed to the position of the instructor's lips and tongue to compare with those positions of his own lips and tongue which he can see in the mirror.

It is well to keep in mind that those words which are of greatest use to the patient are those which have the greatest interest for him, and therefore the greatest stimulating value. After the subject has learned a few words, he should be urged to combine the words by the use of connectives. Speech is not a number of words, but a number of words in connections or relations. Many words may be learned, many combinations of sound may be reacquired without the individual acquiring an ability to combine the words into larger groups. Many motor aphasics reacquire the ability to speak in substantive terms, they can unhesitatingly say numerous words which are the names of objects, but they lack the ability to connect them into combinations which are needed in ordinary conversation. Connectives, and by this we mean conjunctions and certain intransitive verbs, are reacquired with difficulty. This corresponds with what Head has described in cases of so-called sensory aphasia in which there are defects of recognition of relations.

In those whom I have re-educated, I have found that along with the acquisition of some important substantives the patient most readily learns verbs relating to actions. These are in a way concrete like nouns. Words relating to objects of which the patient stands in immediate need as bread and butter, shoes and hat, etc., may be readily reacquired. Some are apparently difficult. I had

a patient, for example, who learned many common nouns in five days or less but who took twenty days to learn "button." At the some time other words dealing with specific activities of the subject like "eat" and "drink," even though they are verbs may also be relatively easy to reacquire. Modifying phrases of all kinds, including adjectives as well as adverbs, are not easily relearned. A few modifying words may be acquired without difficulty, but as in the case of the child they may be more substantive than modifications. The speech of a re-educated individual who has reacquired a certain amount of ability may be disjointed, and what has been called a-grammatical for a long period of time. The speech resembles that of the young child, who uses substantives and active verbs quite freely but who seldom connects the words that he is able to use, and who uses few modifying words and phrases. This is similar to the development of language in primitive peoples. The most primitive language is that in which only verbs of action and object words are used. Later developments added the connectives, the modifiers and the abstract words. The re-educator should not, therefore, be discouraged if great difficulty is encountered in attempting to teach a case of aphemia certain words. The subject may not have reached the stage at which these words have much value for him. The emphasis should be placed upon those things which are most needed by the patient regardless of their conversational value.

It will also be found a matter of much sur-

prise that frequently a patient will be able to acquire the ability to say what appear to us to be long and complex words, whereas he may have difficulty in saying those words which we consider simple and direct. I have found that some patients will be able to use long words much before they acquire certain ordinary simple words which I have tried to teach them. This is not remarkably different from what we find in normal individuals. Children and many adults learn to say words which are fine combinations of sounds, and they may be used without their meanings being known, before they acquire other words which appear to us to be simple.

Since the defect in cases of sensory aphasia is an inability of sensory association and of recognition, the procedures to bring about re-education are those which will tend to get the individual to associate printed or spoken names with certain objects, and names with pictures, the visual with the auditory, etc. In this condition we have to deal with a deficiency which is similar to that in the uneducated child. The principle that is applied in the education of children applies here equally well. It will be recalled that when the child is taught to read he has presented to him a picture, let us say that of a horse, with the corresponding printed word. Or the word may be written on the blackboard, and it is also given verbally by the teacher (auditory stimulus). In this education the attempt is made to bring about an association between the (visual) printed word and the (visual) picture, or between the (visual) written word and the (auditory) spoken

word. All combinations are frequently repeated so that eventually the child learns to associate all together, and all with the real object. In addition the attempt is made to bring about such an association of the printed word with the motor activities of the organs of speech, that the printed symbols result in certain complex vocal activities. This is the method which must be utilized with sensory aphasics regardless of their character.

In general we deal with two types of sensory aphasics, the auditory and the visual, although it must be appreciated that there is a possibility of having an anesthetic or tactile form of aphasia which is also sensory. In both classes of aphasia of these two main sensory types (auditory and visual) the procedures are practically the same. If the aphasia is of a visual character and there is little defect on the auditory side the approach can be made in an auditory way. If the defect is largely auditory the approach must be made from the visual side. In this work I have used simple and complex pictures, shapes, colors, and in fact all materials that can be utilized for the stimulation of the sense organs on the visual side. On the auditory side we are confined in our methods since here we have to deal primarily with those stimuli which are produced by the vocalization of the instructor.

Much use may be made of the phonograph, with musical and other records. It may also be said that rhythm helps, so that poetry, if it is simple, is useful in teaching these patients as well as for the instruction of the motor aphasics. Singing is also of value. Attention has been

called to the fact that some motor aphasics can sing connected words at times when they are unable to carry on a conversation except in substantive form. Some sensory aphasics also are able to associate words more readily with music than when the words are used in conversational speech.

CHAPTER XII

THE PSYCHOTIC.

Unter the heading psychotic I group for convenience all those individuals whose abnormalities are sufficiently acute or sufficiently grave to make the individuals asocial or antisocial. In other words, we include in this group not only those persons who are commonly spoken of as insane and those others who have frank psychoses but also many with the milder manifestations of mental abnormality. Some of the latter do not act or do not have deficiencies of action which warrant their being legally restrained in institutions for their own protection or for the protection of the community. Many of these lesser asocial and antisocial people go about their daily tasks, and partly assume relations to the community. Some we speak of as peculiar or timorous. We find a few who are over-bold, some have phobias, or fears of fire, or of high places, or of open or of closed places, or of persons. Here we would include all of those commonly called neurasthenic or psychasthenic, as well as the hysteric. All of the persons of this group are differentiated from the other conditions with which we have dealt in the last four chapters by having the main manifestations mental. We must not overlook the fact that in many cases these

mentally disturbed people may exhibit apparent physical disorders which simulate or which resemble those which have already been dealt with.

The abnormalities which these patients have are varied. They range from those disturbances of will, or activity, which result in incapacities of a motor kind or in hyperactivities, to disturbances of sensibility, such as hyperasthesias and anesthesias. Some show abnormalities of emotional condition, which may range from depression to elation or to indifference, and be spasmodic or continual. In every case which we examine, we shall note that there is an outward expression of a so-called inward state. The condition which is called depression leads for example to an inactivity on the one hand or to activities which are destructive to the life of the individual such as attempts at suicide. Numerous external stimuli, and also those internally experienced, lead to actions which demonstrate that the individual is not normal. Failure to assimilate stimuli, which are spoken of as hypoesthesia or anesthesia may bring about an inactivity which resembles a disturbance of the so-called will, with results somewhat similar to those which are associated with an organic paralysis.

For all of these cases, regardless of the outward manifestations of the disorder, the general principles of treatment already laid down should be kept in mind. These principles are that the activities of the individual should be so worked over or so reconstructed that the individual be- becomes capable of behaving like the normal people in his environment.

These cases differ from those of the organic type principally in that the habits which are evident are ineffectual or the patients exhibit perverted modes of reaction. In other words the social activities of these patients differ from those of the normal people in the environment. This is evident to such a degree that they are not only noticed and produce comment, but they cause annoyance to those about them. Frequently also their actions are harmful to the patients themselves, and to many other individuals in the community. These activities must be replaced by those habits or actions which are more appropriate to the social stimuli, more suitable to the environment, and more like those of the other individuals in the community.

Having in mind the general principles and the general types of defect which are to be found in these cases, there are certain special principles which must have their application. None of these patients makes a good subject for re-education procedures unless we find four conditions met. In the first place if the individual does not realize that he is different from other people in the community, if he does not realize that in certain respects he is abnormal, it is almost useless to attempt any kind of re-education. The term insight is frequently used to designate the capability of the individual to recognize his mental deficiency or abnormality. It must be understood that the quantity of this insight may vary within wide limits in individuals. Some realize that "in some way" they are different, some realize in particular ways that they are different. They

may recognize the natures of their abnormalities and they may be able to define them frequently much better than the examiner. Insight may also be present in those individuals in whom the recognition of abnormality comes as a compensation for certain of their other deficiencies. Even though they recognize in what particular they may differ from other individuals, they are fitted to retain their individuality in this particular, but they are able to make an adaptation. In some cases the insight may be indirect and may be part of the mental picture. It may, for example, take the form of the recognition of difference, which results in hospital treatment and loss of liberty, but which is a social recognition of his superiority.

The second condition which must be met in order to bring about a sufficient amount and degree of re-education in the psychotic is the desire on the patient's part to get well. In all cases this is not of primary importance although in most cases it is important. If the individual thinks himself to be a king or another high personage, he may lack desire to change his comfortable delusion. He has sufficient insight to recognize a difference between himself and the others, both patients and attendants, who may be about him, but he may lack the desire to become different from what he is. Recognizing his own superiority he does not want to become like the other people. In such a case re-education, no matter how long continued or how actively it may be carried out, may be futile. It is, however, not always essential that the individual desires

to become well, since many procedures may be initiated and carried out which will help towards the eventual social recovery of the individual. The environment may be so constituted or changed that there is a growth or a development of this desire to become normal even though it may not exist in the beginning.

To these two primary requirements there must be added that of self-confidence of the individual: confidence in his ability to overcome the condition or abnormality with which he suffers and confidence in the ability of his advisers, his physician and instructor, to help him to overcome these conditions. This also may be a state of mind which is not present in the individual at the beginning, which may need to be created and fostered by many little instances, or stimuli, which are presented to him. A deep depression, which the patient may have, may prevent his feeling able to get well although he may express a desire to this end and he may recognize his temporary inability. He may also feel that those about him are incapable, but varied means must be used which will help to rid him of these feelings. In place of the hopelessness efforts must be made to produce in him a feeling that something may be accomplished, that there is a possibility of a change taking place and that those about him are capable of helping him in this particular.

These three things may be combined and properly considered to be of primary importance, but even though these three things exist, even though he knows he is not well, even though he desires to get well, even though he feels that he is able

to overcome his difficulty and that the people about him can help him to overcome them, it is essentials as the fourth point that the efforts of re-education should be properly directed. They should not be hit-or-miss methods, they should be directed towards the overcoming of his special difficulties. They should be directed to the formation of those habits of action and of thought which are necessary for the normal individual. They should be adapted to the patient's special mental condition, to his previous education, and to the environment in which he has to live, so that he may carry out his life work in the community as part of it.

Not every psychotic case is amenable or suitable for re-education. It is obvious that in patients with the organic psychoses, such as general paralysis of the insane, the arteriosclerotic and the senile dementias in which there are extensive alterations of the brain, all of whom may be expected to die within a few years, the chances of improvement and social recovery by re-education procedures are relatively slight. At the same time whatever may be accomplished is usually of little value to the individual or to the community in which he lives. That improvement in mental functions or habits may be produced in these organic psychoses can be demonstrated by anyone who is willing to give sufficient time to the training of a patient of this class. Even the memory deficiencies in these organic dementias may be partly overcome by systematic training of the nature of stimulation of the patient, by increasing his interest, by causing him to direct his atten-

tion to details needed for remembering and by compelling him to pay close attention to the various stimuli which come to him. When he attends to the stimuli they have more stimulating value. Because of this they are retained and they can frequently be recalled. Even though the recall may not be as good as that of a normal individual, it can readily be demonstrated that the recall of the stimuli more nearly approaches the normal than in his previous condition.

But, in every case the question which arises and which must be answered is whether or not the amount of time that has to be expended in the re-education is worth while, either for the patient or for the instructor. If the expected improvement is not going to be of great value to the individual patient, if it is not expected to be permanent but only a temporary palliative, or only a demonstration of the capability of re-education, it had best not be attempted except as a scientific experiment. There may be added to this general statement the remark that frequently re-education procedures which are applied to the individual patient are indirectly of value. In some instances this is in relation to the patient's family more than to the patient himself. The patient may be taken as an object of re-education when the actual object is not to re-educate him, but to re-educate the family. In other words, it is often of value to change the mental attitude of the members of the patient's family to bring about in them more normal reactions than they have. Under these conditions the re-education procedures with an apparently hopeless case may

have considerable value, but it should be attempted only with full knowledge of what is to be accomplished. It may not be necessary, and it is frequently inadvisable to tell the family that re-education is for them, but the instructor must know and appreciate what he is doing.

In dealing with the psychotic, much more tact, patience, kindliness, forbearance, and all of the other characteristics of humility are required than in dealing with the organic cases. To bring about a proper attitude in the organic cases, whether central or peripheral paralysis or aphasia, it may be frequently necessary to reprimand him, to tell him how badly he is doing, that he is not doing himself justice, etc. With the psychotic this is not frequently needed and it nearly always leads to a negative reaction which will defeat the ends of the instructor. In special cases great tact is needed. The individual who is depressed must be dealt with quite differently from one who is excited. The patient who is paranoid whether he be depresed or egotistic or exalted, must be humored. Each must be dealt with individually, in accordance with his mood and in accordance with the conditions of his disease and those of the moment.

An instance of how not to begin with the re-education of a patient may well be illustrated. This will also illustrate forcibly what has been done with many psychotics, who get firmly fixed in their disability and who become antagonistic to all efforts at improvement. I was requested by a physician to see a patient who had been diagnosed to have a speech defect of the nature

of an aphasia. The aphasic condition was reported to be due to a gun-shot wound in the neck which was supposed in some way to have produced a loss of the ability of articulation because of severance of some nerves. The patient also exhibited an inability to write which was also supposed to be due to an interference with some parts of the spinal cord or with some elements in the brachial plexus. The symptoms that were apparent to the examiner were the inability to speak or write. These were the facts which were presented to me prior to my seeing the patient. After having detailed to me the conditions which were supposed to be the underlying causes of the patient's defects, and the efforts which had been made toward his re-education, the patient was brought in and was seated near me. After greeting him, I asked the patient his name. His lips moved, but the physician who was present immediately interrupted with the remark: "Mr. ——— cannot talk." I insisted however that the patient had begun to talk to me and that he should be permitted to continue without interference. I assumed and acted upon the assumption that he could talk, and I found that he could talk. Although his voice appeared weak, somewhat tremulous, he verbally gave me his name and subsequently a few details regarding his life. He exhibited no evidences of inability to carry on an ordinary conversation and I assumed at all times that he was capable of doing this. A pencil and paper were then provided which I handed to the patient, placing the pencil in his right hand with the request that he write his name,

his age, the date, his home address, and the place where he then was. Before he could begin this task the physician again advised me, sharply and in tones distinctly audible to the patient, that the latter could not write with his right hand. He also took the pencil from that hand and placed it in the left which he said was being re-educated to take up the writing functions. Without comment I took the pencil from the patient's left hand and placed it in the right hand, and ordered him to write, which he showed he was capable of doing. In this instance the well meaning efforts of the physician were tactless. They were based upon an erroneous diagnosis. Even had the diagnosis been correct it is certain that his method would not be an encouragement to the patient to put forth any effort. His conversation had the tendency to overcome the effects of suggestion which my presence and my words gave to the patient. It had the result of reducing the good attitude which was produced in the patient by having been told that one experienced in re-education of speech defects was coming to see him and advise regarding the best means to be used towards his recovery. From a more careful examination it was apparent that the patient was obviously psychoneurotic, there was great danger that his speechlessness (which was erroneously called aphasia) and his inability to write (which also was erroneously called agraphia) would have been exaggerated or fixed by what the physician said at the time of the interview. It is likely that the negative suggestions to the patient were broken through, to some extent at least, and made

of little avail by the exaggerated reputation which was previously given he.

Improper handling of psychotic cases is not infrequent. The thick application of sympathy may, on the one hand, exaggerate the condition, while on the other hand rough handling and lack of appreciation of his difficulties cause him to shut his shell, so that he cannot be reached. With many psychotics the approach must be made through his confidence, trust, hope, and expectation. And much can be gained by the insistance and assurance of the re-educator. In these cases there is little to keep in mind beyond that of dealing with the patient as if he were normal. It is possible to demand from him what might be demanded as if he was normal. Many things he may be expected to do as a matter of course. If dealt with in this manner there is a tendency to break down or to replace certain ideas which in individual cases bring about unusual reactions. Suggestion in all its forms plays a large rôle in most of the re-education procedures. It may be direct, as an encouragement, or it may be indirect. The suggestion may also come from the subject and this is called auto-suggestion. The encouragements and assurances that the instructor gives frequently lead to auto-suggestions in addition to having value as external suggestion. And, many other procedures, those of examination for example, act to bring about conditions of auto-suggestions also. There are some who affirm its paramount importance in the therapeutic measures of psychoanalysis. Whether one calls this "positive transfer," as does the psychoana-

lyst, or suggestion, or something else makes little difference for the patient and the terminology is of less importance than the helpful production of a hopeful attitude on his part.

It is, however, well to recognize that the essential thing is that the patient shall have confidence in the instructor. If a patient who has been worked with for a few days has shown during this time a lack of confidence in or an aversion for the instructor, it is often best for the instructor to advise the patient to seek the help of someone else. The instructor may not be able to help materially such a patient. His time and efforts may better be expended on those patients who trust him, confide in him, recognize him as a friend and desire his help, and think that he may be beneficial. Patients who are antagonistic, or who in psychoanalytic terms have a negative transfer, are to their own advantage as well as to the advantage of the instructor referred to someone else. Occasionally, especially in institutional work, this is not always possible. It has sometimes been found that even where there is a lack of confidence in the instructor or physician the patient may be persuaded or even compelled to do certain things which in themselves may result in an improvement. The carrying out of some activities under compulsion, just as the administration of drugs under like circumstances, may bring about an improvement. Both the procedures and the resulting improvement may be resented. At a subsequent time, however, they help to change the patient's point of view, so that he then becomes confident and willing, and some-

times even anxious that more active measures be instituted.

As in all other kinds of cases which require re-education the psychotic must have a careful examination of his mental state, his accomplishments, his interests, his plans, and his goal. It is not sufficient to know that the patient shows depression. In the psychotic it is important to know not only that the patient has a phobia or has a delusion or is elated. It is necessary that the whole mental status of the patient be known as far as it can be discovered. At times this necessitates intimate disclosures and confessional confidences, to the detailing by the patient of many shame-provoking occurrences in his past life. Many things may be told he has not told to others. He opens his mind in the way of a confession and frees himself from many peculiar ideas. By itself this catharsis may sometimes result in apparent complete recovery of the individual. He rids himself of those things which are burdens to him—many "old men of the sea"—who have been riding him. I am well aware that this has been disputed, and that there are those who hold that the "censor" and what he does must be understood and that a thorough psychoanalysis must be carried out in these cases if the abnormality is to disappear permanently. This is not, however, the place in which to discuss the relative values of catharsis and complete psychoanalysis, or the importances of mental explanations. Nor is it necessary to discuss the relative values of suggestion, catharsis, psychoanalysis, rest, diet, and the other factors that are

usually present in all "mental" treatments. It is sufficient to know that with some people extensive psychoanalytic measures need not be carried out and that they cannot be carried out successfully. The length of time needed for the treatment of individual cases makes it a "selective" measure, just as in some bodily abnormalities the surgical and medical methods may be selective. It is also important to know that the cathartic action of the detailing of symptoms and of the circumstances attendant upon the production of these symptoms is sometimes sufficient to place the individual back into his usual social life.

The therapeutic approach to the psychotic individual must be preëminently a mental approach. Numerous other measures are available, both as accessory and as primary. Delirium may accompany high fever, or be the result of alcohol or hashish or some toxin in the system. Treatment by mental measures in these patients is less efficacious than treatment for the elimination of the toxin for the rehabilitation of the person. The methods which are available are numerous; the physical methods of hydrotherapy, electrotherapy and kinesotherapy may be used. It is well recognized that hydrotherapy in the form of baths, packs, douches, etc., has value in stimulating or in calming. In conjunction with chemotherapy it may help to eliminate certain toxins from the body. Together the use of baths and drugs may get the individual into a better mental state so that he can more readily be dealt with by one of the methods of psychotherapy. Electrotherapy, perhaps largely through its sug-

gestion value, may also be useful. It should be recognized, however, that many patients have peculiar ideas regarding electricity and electrical forces. Only a careful mental examination will point out these patients, and if special fears or delusions regarding electricity are present the use of this means is usually contra-indicated. In all mental cases it must be used with care so that delusions or fears do not take their origin from the treatment. In those cases in which it is employed it is apparently more valuable in its more spectacular forms, the violet ray, the high frequency currents, and those induced currents of higher voltage which cause considerable skin pain. The last form of electrotherapy has been found extremely useful in dealing with the physical accompaniments of hysteria, such as the paralyses, tics, and anethesias. Yealland has been able to produce apparently miraculous results by its use. The qualification should be made to the last statement that in all probability in all cases the effect has been solely that of suggestion. It is not the direct effect of the electric spark on a paralyzed muscle that is of importance but it is the mental effect produced on the paralyzed mind. Yealland, it should be remarked, did not utilize this method until the patient repeatedly demanded that something should be done for him and that he be cured as Yealland had cured many others. Only the patient with confidence was treated, and when he was treated, the doses were not the minimal ones, and the treatment was continued until the symptoms had disappeared. In the application of the electric current, therefore,

the greatest effect is to be obtained because of the patient's confidence in the efficacy of the operation, confidence that the therapeutist will be able to accomplish almost the impossible. There is also required that the instructor shall have confidence that he will be able to do for the patient what the patient needs to have done.

Movement therapy, or kinesotherapy is also of value in getting the individual started on the road towards taking up some sort of occupation of social value. Misdirected efforts in excitement may be altered into efforts which are produced at command, as in gymnastics. Slow, incompetent movements of the individual who is partially abulic or who is much depressed and retarded may also give away to movements which are more rapid and forceful and purposeful. In many instances class exercises are of value. The individual patient sees other individuals carrying out certain activities. He imitates their actions as one of the group. Imitation is nothing but the acceptance of another's activities as suggestion to action. Association in groups may, therefore, be of value in that what has been called a habit of inactivity may be replaced by one of action similar to the activities of a group of which he becomes a member.

Occupation therapy is also useful. Whether this is carried out in the form of basket weaving or mat making, the making of toys or raffia work, the effort is made solely to get the patient active in directions which are more like those of the normal individual. In themselves such activities as mat making may not be of great value to the

FIGURE 68. Illustration of various bed-side occupations in a sanitorium for tuberculosis. Similar occupations are useful for nervous and mental patients. From McKenzie.

patient. They can be of great value to him in leading him up to other occupations which are normal for his position in the social world, more normal in that they are like those to which he was accustomed and which are needed by him if he is later to be discharged and make his living. Occupation therapy is not, therefore, an end in itself. It is a means to an end. It is useful as the introduction to more usual occupations. It is useful in the production of the habits of directive activity and industry, in the patient. It should introduce and lead directly into occupations which are more generally remunerative. It should help to direct the subject into occupations of a professional or of a trade character.

Occupations which have been called "bedside" have values which are largely mental. In themselves they are of relatively little future use. Basket making and weaving of belts, the coloring of pieces of wood for toys, should be taken as the beginnings of more serious work: embroidery or sewing, housework or gardening, carpentry or plumbing, printing or book binding, and the like. The bedside occupations may be used to direct destructive tendencies of an individual into those which are constructive, or to get the diffuse activities concentrated. In so far as occupation therapy will lead to the return of the individual to the occupation which he had prior to the psychotic development, or to another occupation better suited to his mental level and his mental peculiarities, can occupation therapy be of value. If bedside occupations are not needed by the patient, if his condition is such that he can be given

a saw, a hammer and nails, and the wood, from which he can make a chair or table, without the preliminaries of weaving or bead work, he is that much farther on and has gained that much time towards his eventual rehabilitation. The end of the re-education of the psychotic is to return him to his family and to the community as a working member. At times it is necessary that his occupation should be changed. It may be necessary that the stock-broker should be introduced to many new occupations, to see their possibilities and his possible adaptation to them, in order that he may give up his former occupation, and learn to carry on a business of a less nerve-racking character. It may be that he will find comfort and health as a specialized farmer, or as a small town banker. Or he may become an accountant or become keeper of an inn, something other than that which he formerly was. In other cases it may be that the loneliness of farm life must be replaced by another occupation in a small town or in a large city. These replacement occupations must be learned and the learning of them is part of the re-education of the individual. They are in reality the more important part of occupational therapy, because it is the occupation which will enable the individual to live, and to live so that the psychotic conditions are not again produced.

The untidy and destructive are difficult to re-educate. At first sight they seem impossible of re-education or scarcely worth the efforts at re-education. If re-education is thought to be possible, it is also thought to take more time than

that which can be given to them. This belief is not borne out by the facts. What is required in these cases is that the strength of the stimulus (or situation) shall be sufficient to hold the attention, and lead to another reaction than that of being filthy or untidy or of tearing the clothing, or fighting with other patients. It is a good plan to permit these individuals to associate for part of the day with others who are working, to see what they are doing, to play with gaudy beads and cloth, and to attempt to create the interest in the accomplishment of something. When interest has been created the more formal re-education of the individual may be begun.

Some patients can be appealed to to help out others, to act as assistants, or as crutches for their companions who are less capable than they. The spirit of help, the knowledge that something is being accomplished will soon lead to a recognition of the individual's own usefulness. The assistance to others will serve to show the individual that he is capable of doing something, and this will tend to rid him of self-depreciation, and will also create a proper attitude regarding himself.

The treatment of the psychotic is, therefore, in many respects different from the treatment of the organic groups in that its object is not to deal with muscular activities and motor coördinations of muscle groups. Its object is to deal with the social activities of the individual. In these cases we deal with those conditions which are the ends to be sought in the re-education of the organic cases. But in the organic cases, the emphasis must

be placed on the neuro-muscular coördinations. And, in the psychotic, where the neuro-muscular coördinations are largely intact, we deal with the utilization of them in social complexes. It is sometimes necessary that the grouping and activities of muscles shall be developed in the psychotic. More frequently we are concerned solely with the production of social activities, with re-education exclusively in the sense of getting the individual back into his proper and adequate social status. This means fitting him into an occupation, getting him to modify his views of life's values, teaching him how to get on with his family or to live apart from them, letting him find a goal in life and turning him in the direction of that goal.

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